THE DEVELOPMENT AND TESTING OF THE PSYCHOLOGICAL AND BEHAVIOURAL RESOURCES MODEL OF TEAM FLOW IN PROJECT TEAMS

Weiwei Wang MSc, BA (Hons)

A thesis submitted to the University of Nottingham for the degree of Doctor of Philosophy

December 2019

Table of contents:

Table of contents: i

List of Abbreviations: v

List of figures: vi

List of tables: vii

ACKNOWLEDGEMENTS viii

ABSTRACT ix

CHAPTER I: TEAMS 1

1 Overview 1

1.1 What is a team 1

1.1.1 Team typology and project teams 2

1.1.2 The theoretical and practical importance of project teams 3

1.1.3 Critical conceptual aspects of a team 5

1.1. Team effectiveness frameworks 7

1.1.2. Advancement from IPO to IMOI 9

1.1.2.1 The nested structure in the "I" of inputs 10

1.1.2.2 From the "P" to the mediators and outputs, and the additional "I" in the cyclical dynamics 11

1.2. The team developmental processes: essential theories of team's lifecycle 13

1.3. Multilevel theory of the teams 18

1.3.1. What is emergence? 18

1.3.2. The Multilevel Theory and the emergence of team level phenomena 19

1.3.2.1. The dynamics of emergence 21

1.3.2.2. The many shapes and forms of emergence dynamics 22

1.4. Chapter summary 27

CHAPTER II: TEAM FLOW AND ITS PSYCHOLOGICAL AND BEHAVIOURAL RESOURCES 29

2 overview 29

2.1 Flow 29

2.1.1 The psychic compass for a continuous improvement 30

2.1.2 Nine dimensions of flow: the antecedents, the scaffolds and the core 32

2.2 Team flow--A contagious shared property and a possible indicator of peak team proformance in project teams 34

2.2.1 The conceptualisation and operationalisation of team flow36
2.2.2 The antecedents of team flow at work 41
2.2.3 The mutual feedback loop between the resources and team flow at work 44
2.3 Team efficacy 46
2.3.1 Self-efficacy 46
2.3.2 Team efficacy 48
2.3.3 The reciprocal relationship between team efficacy and team effectiveness 51
2.4 CZPD – the social breeding ground as team resources for flow 54
2.4.1 The zone of proximal development (ZPD) 55
2.4.2 The collaborative zone of proximal development (CZPD) - reaching for a new balance 56
2.4.3 The structural elements of CZPD 57
2.4.4 CZPD, team developmental processes and the affective mechanisms of team flow and team efficacy 60
2.5 Proposing the psychological and behavioural resources of team flow model (PBrTF) 63
2.6 Research objectives and research questions 68
2.7 Chapter summary 73
CHAPTER III: METHODOLOGY AND RESEARCH DESIGN ... 75
3 Overview 75
3.1. A quantitative mixed method design with a pragmatism philosophical perspective 76
3.1.1 The development focus and the research design 78
3.1.2 The data collection strategy and data sources 80
3.1.3 Overview of data analysis strategy 82
3.1.4 Mixed method research quality criteria 83
3.2 Ethical considerations 84
3.3 The development of the CZPD questionnaire 84
3.4. Chapter summary 88
CHAPTER IV: STUDY 1 CZPD AND ITS ASSOCIATION WITH TEAM FLOW AND TEAM EFFICACY 90
4 Overview 90
4.1 Study design 90
4.2. Research questions 93
4.3. Findings and discussion 101

4.4 Conclusion, implications for future studies 122
4.5 Reflectivity 124
4.6 Chapter summary 128
CHAPTER V: STUDY 2 SCALABILITY AND INTERNAL CONSISTENCY OF CZPD – A PILOT STUDY 129
5 Study overview 129
5.1 Study design 129
5.2 Research questions 131
5.3. Mokken Scale Analysis -- A Theory of Data and Analytical Strategy 132
5.4 Results 140
5.5 Discussion and further research 145
5.6 Chapter summary 148
CHAPTER VI: STUDY 3 DIMENSIONALITY AND DIMENSIONAL STABILITY OF THE MEASURES 150
6 Overview 150
6.1 Testing measurement invariance 150
6.1.1 Study overview 150
6.1.2 Study design 151
6.1.3 Sample, procedure and measures 152
6.1.4 Ethical considerations 157
6.2 Research questions 158
6.2.1 Method—the data analytical design 160
6.2.2 The results 170
6.3 Discussion, conclusion and future direction 172
6.4 Chapter summary 178
CHAPTER VII: STUDY 4 TESTING THE HYPOTHESISED PSYCHOLOGICAL AND BEHAVIOURAL RESOURCES MODEL OF TEAM FLOW (PBrTF) 179
7 Overview 179
7.1 Testing the causal relationships of the hypothesised PBrTF model 179
7.1.1 Study overview 179
7.1.2 Study Design 180
7.1.3 Sample, procedure and measures 180
7.1.4 Ethical considerations 180
7.2 Research questions and hypotheses 180
7.2.1 Method 185

7.2.2 Data Screening and Preliminary Analyses 192
7.2.3 Model Testing 200
7.2.4 Comparison of models and summary of Findings 204
7. 3 Discussion 205
7.4 Chapter summary 212
CHAPTER VIII: CONCLUSION AND FUTURE DIRECTIONS 214
8 Overview 214
8.1 The research objectives 214
8.2 Limitations 238
8.3 Theoretical contributions 241
8.4 Implications and suggestions for future research 244
8.5 Conclusion 250
REFERENCES 253
APPENDIX 280
Appendix A: Participant information sheet and consent form of Study 1 281
Appendix B: Study 2 Participant information sheet, consent form and the questionnaire 287
Appendix C: Participant information sheet, consent form and Study 3 and 4 Questionnaire 293
Appendix D: Ethics Approval letter with the corrections 303
Appendix E: Factor analysis CZPD 305

List of Abbreviations:

AISP: automated item selection procedure

CE: collective efficacy

CFA: confirmatory factor analysis

CSR: contextual structure of reference

CZPD: collaborative zone of proximal development

DMM: double monotonicity model

EFA: exploratory factor analysis

FSS: Flow State Scale

ICC: intraclass correlation coefficients

IIO: invariant item ordering

IMOI: input-mediator-output-input model of team effectiveness

IPO: input-process-output model of team effectiveness

IRR: inter-rater reliability

IRT: iteam response theory

MHM: monotone homogeneity model

MSA: Mokken scale analysis

SCT: social cognitive theory

SEM: structural equation modelling

TFa: team flow antecedents

TFc: team flow core experience

WOLF: WOrk-reLated Flow inventory

List of figures:

Figure 1-1: The Input-Process-Output (IPO) team effectiveness Framework _____ *9*

Figure 1-2: Input-Mediator-Output-Input (IMOI) Team Effectiveness Framework. _____ *10*

Figure 1-3: Metatheory of team development and performance compilation model _____ *16*

Figure1-4 a: Convergent linear emergence _____ *24*

*Figure1-4 b: Within-team variability in emergence*_____ *24*

*Figure1-4 c: Shift from convergent to divergent emergence*_____ *24*

Figure1-5a: Positive growth trajectory in the level of an emerged property _____ *25*

Figure1-5b: Negative growth trajectory in the level of an emerged property _____ *26*

Figure1-5c: Discontinuous shift in the level of an emerged property _____ *26*

*Figure1-5d: Entrained cycles in the levels of emerged properties*_____ *26*

Figure 2-1: Vygotsky's zone of proximal development (ZPD) _____ *55*

Figure 2- 2. Personal, environmental and behavioural influences _____ *64*

Figure 2- 3. The proposed Psychological and Behavioural resources model of Team Flow ___ *68*

Figure 3- 1: Mixed methods design continuum _____ *78*

Figure 3- 2: Overall research design. _____ *80*

*Figure 7- 1: The stylised proposed PBrTF model (the causal model)*_____ *184*

Figure 7- 2: The proposed cross-lagged panel model of a half-longitudinal design. _____ *190*

Figure 7- 3: The stylised PBrTF model with results. _____ *203*

*Figure 7- 4. The cross-lagged panel model of PBrTF with results.*_____ *204*

Figure 8- 1. CZPD scale development flowchart. _____ *232*

List of tables:

Table 3- 1: Studies overview ____ *75*
Table 3- 2: Dimensions and sub-dimensions with corresponding items ____ *85*
Table 3- 3: Best practice recommendations for scale development ____ *88*
Table 4- 1: Interview schedule ____ *95*
Table 4- 2: Table of themes and subthemes. ____ *99*
Table 5- 1: Mean Item Scores, standard deviations, and Results ____ *143*
Table 5- 2: Item Content, Mean Item Scores, Standard Deviations, and Results ____ *144*
Table 6- 1: CZPD scale (16-item version) used in Mokken Scaling Analysis. ____ *153*
Table 6- 2: Perceived collective efficacy scale (CE) ____ *154*
Table 6- 3: Perceived team flow antecedents scale (TFa) ____ *155*
Table 6- 4: Perceived team flow core experience scale (TFc) ____ *156*
Table 6- 5: MSA results of perceived collective efficacy scale (CE) ____ *163*
Table 6- 6: MSA results of perceived team flow core experience scale (TFc) ____ *164*
Table 6- 7: MSA results of perceived team flow antecedents scale (TFa). ____ *165*
Table 6- 8: MSA results of CZPD scale (16-item version) ____ *167*
Table 6- 9: CZPD scale (12-item version) to be used in study 4. ____ *176*
Table 6- 10: Perceived team flow core experience scale ____ *177*
Table 7- 1: Means, standard deviations, reliability and correlations for the study variables. *193*
Table 7- 2: Aggregation results for consensus composition models. ____ *199*
Table 7- 3. SEM models goodness of fit ____ *201*
Table 7- 4: Research Findings ____ *205*

ACKNOWLEDGEMENTS

I have so many people who I am forever grateful for their support on this research journey. First, I must thank my PhD supervisors Dr Angeli Santos and Professor Cees van der Eijk for their wise guidance, abundant feedback and kind encouragement. Without their support, this research journey would be a completely different story. I think of myself as one of the luckiest PhD students for having them as my supervisors.

Although for the sake of anonymity and confidentiality, I cannot name them, I would also like to thank my participants and their course convenors who offered to contribute to this scientific quest with a passion for research and knowledge. It was their generous contribution that helped me through the difficulties of the data collection process. I remember someone put a smiley face on their questionnaire and left a note to me saying: *stress does not help*. And a handful of people also have written down comments in between the lines of the questionnaire items, sharing their thoughts and experience about teamwork. I do not know your names or where you are now, but thank you so much.

ABSTRACT

This thesis explores the development and testing of a psychological and behavioural resources model of team flow (PBrTF) in project teams, which is an tool to promote team effectiveness proposing that team efficacy and CZPD act as psychological and behavioural resources of team flow and that these three team level phenomena share a positive, mutually reinforcing relationships. Four studies were implemented to achieve the above-mentioned research objectives. The first study describes how team efficacy and CZPD interact to promote the emergence of team flow using a qualitative approach. The second study tests the scalability of the CZPD questionnaire, which resulted a 16-item unidimensional scale representing five aspects of an effective self-organising peer-learning entity. The third study validates the cross-time dimensional stability of the all four scales. The fourth study tests the cross-time reciprocal relationships between team efficacy, CZPD and team flow. This study also tests whether team flow antecedents mediate the effects of team efficacy and CZPD on team flow.

The results partially support the PBrTF model, showing that team efficacy and CZPD share a mutually reinforcing relationship over time. CZPD predicts the emergence of team flow and this effect is completely transmitted to team flow by team flow antecedents. Contrary to the prediction of the PBrTF model, however, team flow does not predict CZPD. This result raises a practical challenge to the widely accepted conceptualisation of team flow and team efficacy and potentially the theorisation of the PBrTF model and suggests that team efficacy and team flow might do each other a disservice. The conclusion of the thesis discusses the implications of the study results and the potential contribution of the PBrTM model to enhance team effectiveness in project teams.

CHAPTER I: TEAMS

1 Overview

As this research aims to investigate the nature and relationships between team-level constructs to develop a tool for team effectiveness, the first chapter of this thesis begins by reviewing the current literature about teams. Using the four conceptual foci of team research proposed by Kozlowski and Bell (2013), relevant constructs and frameworks including team typology, team lifecycle models, team effectiveness framework and the multilevel theory of team level phenomena are discussed to form a relatively comprehensive picture of team life. The chapter concludes by discussing how these theories could facilitate the conceptualisation and operationalisation of the focal team level phenomena of this thesis in a complementary manner.

1.1 What is a team

Work teams and groups often exist in different sizes and types, serving a variety of functions, with their own internal processes and external linkages (Kozlowski & Bell, 2013). Integrating the views from experts of team effectiveness (Hackman, 1992; Hollenbeck Ilgen, Sego Hedlund Major & Phillips, 1995; Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996; Salas, Dickinson, Converse, & Tannenbaum, 1992), Kozlowski and Ilgen (2006) provide a comprehensive definition of a team:

> *A team can be defined as (a) two or more individuals who (b) socially interact (face-to-face or, increasingly, virtually); (c) possess one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment* (Kozlowski & Ilgen, 2006; p79)

Chiocchio (2015) argues that Kozlowski and Ilgen's (2006) definition takes into account the key influential factors. However, despite its comprehensiveness, such definitions of teams were developed to describe all types of teams in general. For theory refinement and research precision, team scholars, therefore, went on to specify different types of teams.

1.1.1 Team typology and project teams

Team typology serves the function of delineating and distinguishing teams with underlining factors (for example, contextual differences) that constrain and influence the effectiveness of varying types of teams. It is in the interest of team scientists to pay attention to team typology as it promotes theoretical integration and precision and identifies the contextual differences that influence the performance and management of different types of teams (Kozlowski & Bell, 2013). Such a specific classification and categorisation guide a well-tailored design and operationalisation of future research and intervention and benefits effective practical applications. Many team science scholars have proposed different models of team typology to distinguish teams (Bell & Kozlowski, 2002; Kozlowski, Gully, Nason, Smith, 1999;). Despite the differences in their perspectives, all team typology models serve the purpose of classifying and describing teams to identify the uniqueness in the contingencies and/or confounding factors such as the team's tasks, the organisational context it nests in and, its size and tenure. However, it is worth noting that team typology is only a means to the end. Overemphasis on team typology is misguided and overly descriptive and it runs the risk of simplifying team science. The literature of team typology recognises many types of teams, for example, a general typology distinguishes production teams, service teams, management teams, project teams, action and performing teams, and advisory teams (Sundstrom, McIntyre, Halfhill, & Richards, 2000).

To better distinguish project teams from other types of teams (e.g. production, serves teams, management etc), it is best to start from the definition of a project task. Kozlowski and Bell (2013) briefly defined that "*Project teams are temporary entities that execute specialized time-constrained tasks and then disband (e.g., new product development)*" (p7). Scholars have made continuous

efforts to define project tasks (for a sample list of definitions see Hobbes, Chiocchio, & Kelloway, 2015) and consensus has been reached in the literature capturing key features of project work as "*A temporary endeavour undertaken to create a unique product, service, or results*" (Project Management Institute, 2013, p. 1).

From this definition, it is clear that three defining features capture the essence of project tasks and differentiate it from non-project tasks:

1. Temporary: projects are designed to last for only a specific period of time, meaning that they have a beginning and an end. An example type of tasks that's different from project tasks is operational processes, which are often continuous.
2. Product uniqueness: a project delivers unique results, products or services. While it is hard to define what constitutes uniqueness, projects are usually not repetitive, involve limited or no routine elements. Routines are usually established before tasks and produce standardised results (Chiocchio et al., 2015).
3. Progressive elaboration: this term implies time and effort which are associated with 'creation' in line with the abovementioned definition of project work. Progressive elaboration is thus defined as "*the interactive process of increasing the level of detail in a project management plan as greater amounts of information and more accurate estimates become available*" (Project management Institute, 2013, p.552). This concept can be applied to a project's unique process of creation which is typically poorly defined when the project starts but then becomes better defined as the project unfolds. The nature or essence of project tasks implies an ongoing process of task definition and redefinition, goal setting and clarification, solution forming and refining, that project teams normally go through across its lifespan.

1.1.2 The theoretical and practical importance of project teams

Of all types of teams, project teams are one of the most common types deployed in modern organisations and are arguably the "*most important type of teams that comprise the units of study in this field*" (Hollenbeck, Beersma, & Schouten, 2012, p103). Project work is common in all sectors partly because of

the proliferation of technology and innovation, and shortened replacement cycles of products in the globalisation of markets (Bredin & Soderlund, 2011). The 'projectification' of activities, therefore, serves as an effective means to quickly adapt to intensive changes and the demand for creativity and innovation (Burnes, 2009). As the nature of economic organisations becomes more temporary (Castells, 2009), scholars have observed more project activity related publications (Wageman, Gardner, & Mortensen, 2012). Education systems have also responded to this trend by including more project work structured team activities and offering project management degrees (Chiocchio et al., 2015). The World Bank (2012) estimates that 20% of the world economy is represented by capital investment in infrastructure such as buildings, equipment and software etc. that are mostly carried out in the form of project works.

Moreover, the impact of the work of project teams has a lasting effect. Project teams are used to implement innovation and changes that entail important structural effects (Chiocchio et al., 2015). For example, when a project team is put in place to carry out changes in operational processes, the project team would disband after task completion; however, the new operational process continues for a prolonged period. Project teams are also frequently used in the implementation of strategic plans (Morris & Jamieson, 2005), which also implies a prolonged and extended impact that is difficult to quantify accurately.

Albeit team science is a well-established area in organisational psychology, project teams, are not well sampled in this line of research (Chiocchio et al. 2015). Chiocchio et al. (2011) find that in the leading organisational psychology journals, project teams are only represented by about 6%. More often than not, when project teams and project workers are sampled, they are included in combination with non-project teams, and often, it is unclear what type of teams have been sampled (Chiocchio & Essiember, 2009). Although human factors had long been recognised as one of the key predictors of project team success (Chiocchio & Essiembre, 2009), there is a gap in the literature. Project team researchers often overlook the importance of team motivation and development; and the general team science researchers in general have failed to notice the role of project team structure in team effectiveness (Chiocchio& Essiember, 2009). In actuality, the

broader field of team science and the specific area of project teams are complementary in nature. Framing the discussion of team science within the contextual intricacies of project teams enriches the explanation of results and contributes to the advancement of both areas. Research on team science has encouraged researchers to put more attention on the dynamic nature of collaboration within a team's lifecycle (Kozlowski, 2015) and calls for a focus on the evolution of teams over time (for a detailed discussion see the team effectiveness in section 1.1). As discussed above, one of the characters of a project is that it has a clear start and endpoint. The temporary nature of projects makes it relatively easier to identify stages in the developmental process of a team (for a detailed discussion see team lifecycle in section 1.2), which serves as a framework for the study of team evolution and dynamics of team level phenomena more efficiently. Therefore, placing the research of team science in the context of project teams advances our understanding of team dynamics and enriches the discourse of team science in organisational psychology (Hobbes et al., 2015). The above discussion, which serves as an exploration of how things might differ in a project team compare to other type of teams (e.g. production, service, advisory etc.), also helps set the scene for the data collection for this project.

1.1.3 Critical conceptual aspects of a team

The above discussion positions the research of project teams by demonstrating its popularity and importance in the field of team science. In general, research on team science has shown that there is a multilevel reciprocal relationship between the organisation, the team and its individual members (Kozlowski & Bell, 2013). Teams are by definition nested within an organisation, which imposes top-down constraints that directs team functioning. Individual members nested within the team respond to these constraints in a complex manner that, in the process of fulfilling its function, manifests, in a bottom-up fashion, through various kinds of cognitive, affective and behavioural emergent phenomena (Kozlowski & Klein, 2000). This three-way reciprocal relationship between the organisation, the team and its members, involved in the study teams, necessitates four essential conceptual issues that must be considered: multilevel

influence; contextual constraint and creation, task or workflow interdependence and temporal dynamics.

(1) Firstly, the *multilevel hierarchical* nature of organisations entails multilevel influences, which demand a multilevel perspective regarding theoretical, measurement, and data analytical strategies. Such precision in a multilevel perspective ensures a meaningful conceptualisation and empirical research of a multilevel construct. The following discussion will attempt to further develop the understanding of the multilevel hierarchical nature of organisations from the perspectives of the IMOI framework of team effectiveness (section 1.1), team lifecycle models (section 1.2) and multilevel theory (section 1.3). The multilevel perspectives also informs the conceptualisation of one of the focal construct of collaborative zone of proximal development (CZPD) in Chapter II. The methodology used to aggregate the team level variable in Chapter VII is also based on this perspective.

(2) The *contextual creation and constraint* of a team is a combined product of the top-down forces from the organisation which is the combined influence of structure, culture, climate and technology etc., and bottom-up emergent phenomena of team member interactions and team processes. The section on Multilevel Theory (section 1.3) and especially the section on the emergence of team level phenomena (section 1.3.2) will provide a detailed discussion on the conceptualisation issues regarding the contextual constraints and creation in teams in this research.

(3) *Workflow interdependence* is mostly determined by technology, which indicates how outputs are converted from system inputs (McGrath & Hollingshead, 1994). This structure of workflow, which could be pooled, sequential, networked or additive, determines the member interaction configuration and plays an essential role in influencing team effectiveness as well. One of the focal concepts of this research, CZPD, has two aspects named idea interaction and decentralised control, which are conceptualised as two indicators of a team's interaction configuration as a result of a team's workflow interdependence. Detailed discussion is presented in section 2.4, Chapter II.

(4) Team processes unfold over time through a lifespan of formation, maturation, evolvement continuance and decline (Morgan, Salas, & Glickman, 1993). Complex team dynamics phenomena such as team cohesion or collective efficacy, emerge, fluctuate, diverge or decline as members interact over time through the lifecycle of a team (Kozlowski et al., 1999). All team level phenomena are related to time and the construct of *temporal dynamics* is vital to the understanding of team effectiveness and processes. The discussion on team development process in section 1.2 as well as the conceptualisation of CZPD in Chapter II are based on this perspective.

Team science has developed a rich literature of theoretical frameworks in an attempt to conceptualise and operationalise the above mentioned four conceptual foci of team research. The following section discusses the IMOI team effectiveness frameworks, team lifecycle models and the Multilevel Theory of teams, by delving into a detailed discussion of these three distinct, yet mutually complementary, theoretical and analytical perspectives of teams. Taking into account the temporal issue, the IMOI team effectiveness frameworks guide the conceptualisation of the associations and relationships between team level phenomena. The discussion on team lifecycles describes the critical steps necessary for the establishment of a coherent team considering both internal and external influences. The multilevel theory is a mate-discourse theorising the multilevel hierarchical nature of teams and the discussion on emergence dynamics facilitate the operationalisation of the nested structure of team events. The research foci and team theories discussed here have implications for all types of teams, including project teams.

1.1. Team effectiveness frameworks

Regardless of the type, teams are formed to perform. Performance is, therefore, the natural criterion variable that is widely investigated in most organisational behaviour and human resource management literature (Bommer, Johnson, Rich, Podsakiff, & MacKenzie, 1995). However, the construct of performance, in comparison to team effectiveness is said to be narrow in focus and does not reflect the wealth of reality of teamwork (Mathieu & Gilson, 2012).

Instead, team effectiveness is the core focus of theories and research on teams, and almost all topics studied on teams are somehow connected to team effectiveness (Mathieu, Maynard, Rapp & Gilson., 2008). The nature of team effectiveness is multifaceted; it usually implies mature teams that have passed the initial composition and development phases and are amid enhancement phases where team level phenomena begin to take shape or emerge through a bottom-up process. Therefore, effectiveness frameworks are particularly useful in assisting the theorisation of the relationships between emergent team level phenomena. As a multifaceted area, team effectiveness is driven by criteria that are both internally orientated, such as team satisfaction and viability, and externally orientated, such as team productivity and performance (Hackman, 1987; Mathieu et al. 2008). This broad array of potential drives makes team effectiveness an all-encompassing umbrella concept but at the same time suffers from a theoretical imprecision. In other words, the meaning of team effectiveness can be case-specific. Therefore, for accurate theorisation and valid operationalisation, researchers are recommended to identify the particular such as the team type, the in roll and extra roll performance criteria of the targeted sample (Goodman, Ravlin, & Schminke, 1987, Mathieu & Gilson, 2012).

1.1.1. The IPO heuristic

Although team effectiveness is multifaceted, complex and case-specific, the development of team effectiveness theories is mainly rooted in the input-process-output (IPO) model (see Figure 1-1). McGrath's (1964) IPO model has been used as a valuable conceptual framework in the research of team effectiveness for more than 40 years. In this model, factors comprising a team, such as individual member characteristics, skills, expertise, personality and experience as well as organisational and contextual variables such as team resources are defined as *inputs* (Mathieu et al., 2008). *Outcomes* are described mostly as team performance, team viability and indicators of members' wellbeing such as work satisfaction. *Processes* are explained as member actions and interactions that are driven by task goals and resulting accomplishments (Hackman, 1987; Mathieu et al., 2008). IPO has been the most influential heuristic that inspired the development many team effectiveness models.

However, it was not meant to be a causal model. McGrath (1964) intended IPO to be a framework used to organise the team science literature and theories. As a result, assuming a causal linkage underlying IPO is actually misguided and has led researchers to treat team processes as frozen and static, and disregarding the temporal dynamics and cyclical nature of a team's lifecycle. Another issue with the IPO model is that it simplifies team processes by putting it in a black box (Kozlowski, 2018; Mathieu et al., 2008). Although modifications and extensions have been made to the IPO model (Cohen & Bailey, 1997; Hackman & Morris, 1975), it still fails to account for the sophistication entailed in various types of team processes.

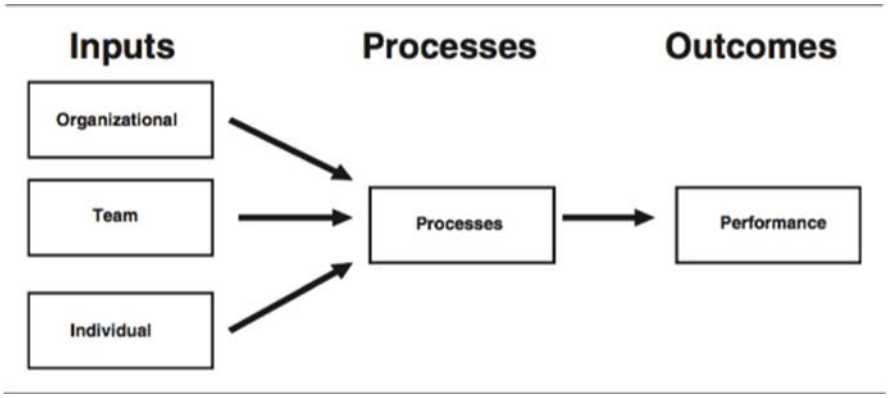


Figure 1-1: The Input-Process-Output (IPO) team effectiveness Framework (adopted from Mathieu et al. 2008).

1.1.2. Advancement from IPO to IMOI

Recent developments in team effectiveness theories and models have taken a more dynamic stance, acknowledging the reciprocal temporal dynamics rooted in team effectiveness processes and attempted to accommodate the complex multilevel and emergent phenomena across the levels of the individual, the team, and the organisation (Kozlowski & Bell, 2013). Ilgen, Hollenbeck, Jonson and Jundt (2005), consolidated efforts of team science scholars who tried to expand and improve upon the IPO (Cohen & Bailey, 1997; Hackman & Morris, 1975; Ilgen et al., 2005;; Salas, Dickinson, Converse, & Tannenbaum, 1992), through the input-mediator-output-input (IMOI) model of team effectiveness.

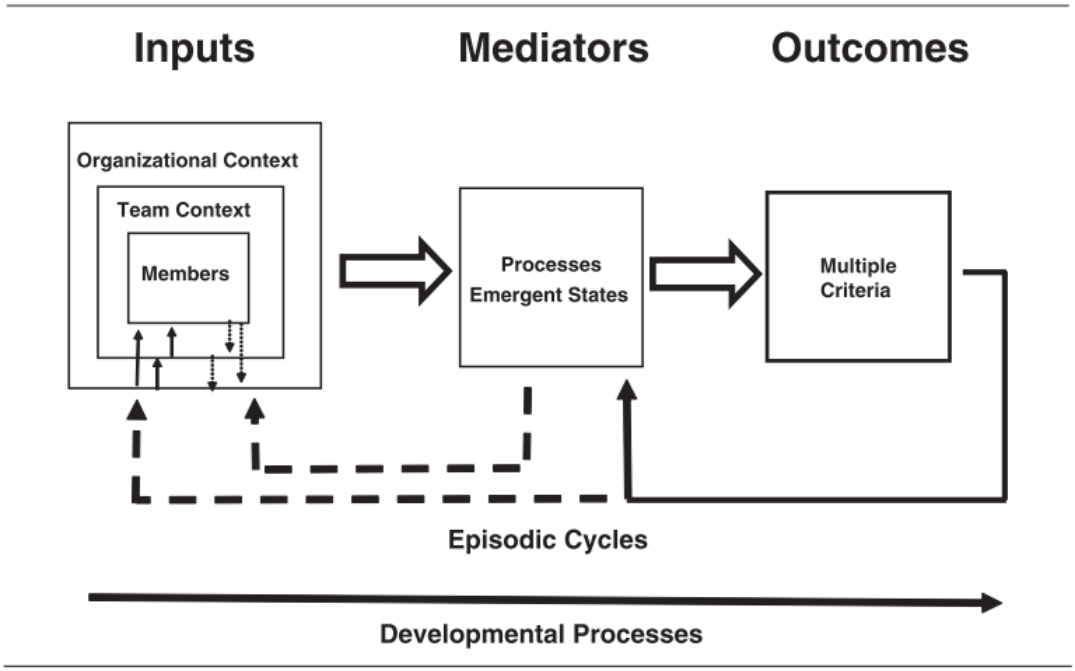


Figure 1-2: Input-Mediator-Output-Input (IMOI) Team Effectiveness Framework (adapted from Mathieu et al. 2008).

1.1.2.1 The nested structure in the "I" of inputs

Compared to the IPO, the IMOI model recognises the nested nature of teams by conceptualising a multilevel structure of the *inputs*. This multilevel dynamics is illustrated in the inputs where the individual is nested in the team context, which in turn is nested in the organisational context. The solid arrows pointing inward from the organisational level to the members through the team context represent the top-down influence where members act in accordance with the requirements from a higher level, e.g. the team or the organisation. The dashed arrows pointing outward from the individuals to the team and then further to the organisation show the bottom-up effects of a multilevel entity. It is worth noting that the bottom-up effects, represented by the dotted lines, are proposed to be less influential than the top-down effects, drawn as the solid lines. This assumption is based on the logic that the strength of the situation (top-down effect) has a more prominent impact than that of a bottom-up effect in the formation stage of a team and is thus usually conceptualised as inputs.

1.1.2.2 From the "P" to the mediators and outputs, and the additional "I" in the cyclical dynamics

In addition to the multilevel nature and temporal dynamics of teams, IPO is also criticised for placing team processes in a "black-box", failing to identify and distinguish a wide range of "processes" which are proposed as mediators in IMOI. Distinct from team task processes which comprise of specific activities such as analysing the task, planning and conflicts managing etc. (Driskell, Salas & Driskell, 2018), team processes pertain to the cognitive, motivational and affective, and behavioural factors that foresters team effectiveness (Cohen & Bailey, 1997; Marks, Mathieu & Zaccaro, 2001). Mediators or the "M" in IMOI are referred to as emergent phenomenon. Moreover, IMOI also takes into account the passage of time (Mathieu et al., 2008; Marks et al., 2001). In team science, the role of time is conceptualised in many ways, among which two are most influential: one is the developmental approach, and the other is the episodic approach. Kozlowski, Gully, Nason and Smith (1999) proposed the *developmental model* and claimed that teams mature qualitatively over time under the influence of various factors. The *episodic approach*, on the other hand, proposes that teams mature episodically while executing different tasks, emphasising the cyclical nature of task demands. Incorporating these two influential conceptualisations of time, the IMOI model assumes that the influence of the temporal dynamics of a team phenomenon can be seen as both linearly continuous and episodically cyclical in nature (Ilgen et al., 2005). This idea is better illustrated in Figure 1-2.

Depicted as the solid line running along the bottom of Figure 1-2, a continuous developmental process transmits the effect of inputs to the mediators and then to the outcomes in a linear fashion. However, the event does not come to a stop here. From one episode to the next, the impact of the outcomes from the previous episode carries a reciprocal effect on the inputs and mediators of the next episode, where the additional "I" indicates the ongoing development of events in a team. It is worth noting, however, that the influential power of the outcomes of the last episode is stronger on the mediators of the subsequent episode (solid line) than on the subsequent inputs (dashed line). Mathieu et al., (2008) explains that this disparity in the influential powers is based on the

assumption that the emergent team phenomena such as collective cognition and/or affect are more sensitive to feedback from the outcomes of the previous episode than the impact of the inputs or the contextual variables such as team structure or member composition. This reasoning is based on the Multilevel Theory and the dynamics of emergence, which will be discussed later.

Taking into account the various processes and the reciprocal nature of team life, IMOI facilitates the theorisation of the associations between team process variables and how these relationships evolve over time. Marks et al., (2001; p358) argues that *"...although researchers have not typically classified them as such, emergent states can be considered as both team inputs and proximal outcomes...Emergent states do not represent team interaction or team actions that lead toward outcomes. Rather, they are products of team experiences (including team processes) and become new inputs to subsequent processes and outcomes*". This argument is consistent with the cyclical nature of time dynamics depicted in the IMOI framework and therefore, whether to treat team emergent states as the input, mediator, moderator or the consequences in a cross-sectional design is largely dependent on the research questions. In longitudinal designs, however, the research question should address the potential for cyclical and reciprocal relationships. Moreover, recognising that there are multiple criteria for team effectiveness, Mathieu and Gilson (2012) contend that there can be a wide range of team effectiveness criteria, such as productivity, efficiency and quality as performance-related criteria, and collective emergent states such as collective efficacy, team cohesion, etc., and individual attitudes, reactions and behaviours. Granted, having multiple sources of team effectiveness information would be most ideal. However practically speaking, different sources of information are suited for different types of investigation. Mathieu and Gilson (2012) recommended that forming a suitable configuration of effectiveness criteria is a balanced consideration over the type of teams studied, resources available and logistical challenges among others.

Given the variety of processes that could emerge in a team context and the possible cyclical and reciprocal relationships between these processes, the IMOI provides a comprehensive framework of team effectiveness which takes into

account the four conceptual foci proposed by Kozlowski and Bell (2013). However, as mentioned at the beginning of this discussion, the discourse of IMOI assumes that the relevant team phenomena have already emerged or taken shape, leaving the steps leading to the emergence and the role of team developmental processes unaccounted for. Therefore, to appreciate an even more in-depth, detailed understanding of the temporal dynamics of team phenomena, we now turn to a discussion of team lifecycle theories.

1.2. The team developmental processes: essential theories of team's lifecycle

1.2.1. The classical linear stages approach

Kozlowski and Bell (2013) reviewed the literature on team lifecycles and identified a school of descriptive models (e.g. listed in a table in Kozlowski and Bell, 2013; p103) similar to Tuckman's (1965) classic stage model of group development. These stage models outlined, in general, four stages in the developmental process of a team: forming, storming, norming and performing, which is perhaps the most well-known and wide-spread theory of team lifecycles. According to Tuckman (1965), in the initial *forming* stage, when group members are just assembled, they try to define the team task and form a way to accomplish it. In this stage, members explore and seek the formation of a social structure. While in the process of trying to define the task and approaches to accomplish it, the team enters a *storming* stage as they start arguing about which course of action to take. In this stage, conflicts might breed factions and cliques take shape, which results in a divergence of perception and emotion within the team. When the team finally manages to reach an agreement after reconciling their differences in opinions, responsibilities and loyalties, a common ground of status, roles and rules gradually established. The social hierarchy stabilises. At this point, a team enters the *norming* stage in which members begin to share common goals and views, and cooperate in a more cohesive manner with less conflicting emotions and objectives. With this convergence of expectations, a team enters the *performing* stage where the concentration is on achieving their collective goals. At this stage, members become much more satisfied with and attached to their team.

1.2.2. The episodic approach: Punctuated equilibrium model

In contrast to the internally oriented stage models, Gersick (1988, 1989) proposed a two-stage punctuated equilibrium model (PEM) of team development. The main assumption underpinning PEM is that, instead of a linear progression of a uniformed series of fixed stages, a team's pace of development is dictated by externally imposed deadlines. Kelly, Futoran, & MaGrath (1990) echoes this assumption and reasons that, apart from the internal processes, work teams are also subjected to influences from their external environments which regulate the rhythm of teams' activities. The change of pace enables team adaptation and development. Gersick observed that a team's developmental process is marked by two distinct periods. In the first half, it is characterised by a state of inertia whereby members interact to build a stable norm that governs team activity. In the second half, as the deadline of the project draws closer, the team reorganises itself to concentrate on completing the task. Gersick coins this period of significant transformation *the punctuated equilibrium*. Using Evolutionary Biology as an analogy, the punctuated equilibrium of a species' evolution involves a long period of stability (stasis) in which the population of this species is stable and shows little evolutionary changes. And then responding to a powerful environmental stimulus, a rare and rapid burst of evolutionary event occurs (Cladogenesis) before the evolved species settles in the next period of stasis. (Kozlowski & Bell, 2013).

The classical stage models of team development serve as a good basis for describing social interactions within teams. They focus on simple types of teams with a lack of clearly defined workflow and an emphasis on internal contingencies that are characterised by interpersonal ambiguity and conflicts. Members in these types of teams seek, primarily, the establishment of a social hierarchy and a common ground of norms to guide interactions. However, this internal focus of stage models has four general limitations. Firstly, they often neglect the organisational context surrounding work teams, which means that a lot of the time, when new teams are formed, they often display a common ground of norms and social hierarchy inherited from the wider environment of the organisation. Second, stage models do not take into consideration the nature and implication of team tasks, and how the dynamics and temporal constraints team tasks regulate the

tempo of team activities. Instead, stage models assume team tasks are isolated singular events such as project planning, decision-making and problem-solving etc., which are mainly driven by internal environments. However, the nature of work team tasks is usually dynamic with varying degrees of complexity and pace, which can subject teams to episodic cycles of demands, rather than a continuous, linear stage. Third, as stage models are developed to describe teams with unstructured task flows, they place more emphasis on interpersonal attraction and conflicts. Therefore, the growth of task-related interactive patterns is unaccounted for. Fourth, stage models assume a collective orientation of teams, which is representative of the simple aggregation of team outcomes. However, when it is necessary to distinguish between contributions from the individual, dyads and the entire team, stage models are not sophisticated enough to guide the operationalisation. Fifth, as stage models are descriptive in nature and focus only on reporting the individual issues, their consequences and their solutions in terms of the process, and the development of the work teams are not accounted for.

Although PEM is developed in the context of project teams with a finite lifespan and fixed goals, it is widely applicable in modern organisations. What is commonly regarded as the most important advantage of PEM over classical stage models is that, in addition to internal factors, it incorporates the influences of external contingencies as a contributing factor to team development, an essential aspect of a team's lifecycle overlooked by classical stage models. Nevertheless, classical stage models and PEM are not regarded as competing theories of team development. Instead, Chang, Bordia, and Duck (2003) contend that these two types of models are more or less complimentary. They suggest that if the focus of analysis is on the process and social structure of a team, a micro-timing approach emphasising the linear development is more suitable. On the other hand, if the research interest is macro timing oriented, PEM would be a framework providing more support to the understanding of the team's approach to its task. This observation suggests that neither of these two perspectives alone is adequate to support a comprehensive understanding of team development processes. Thus a more integrative approach is called for.

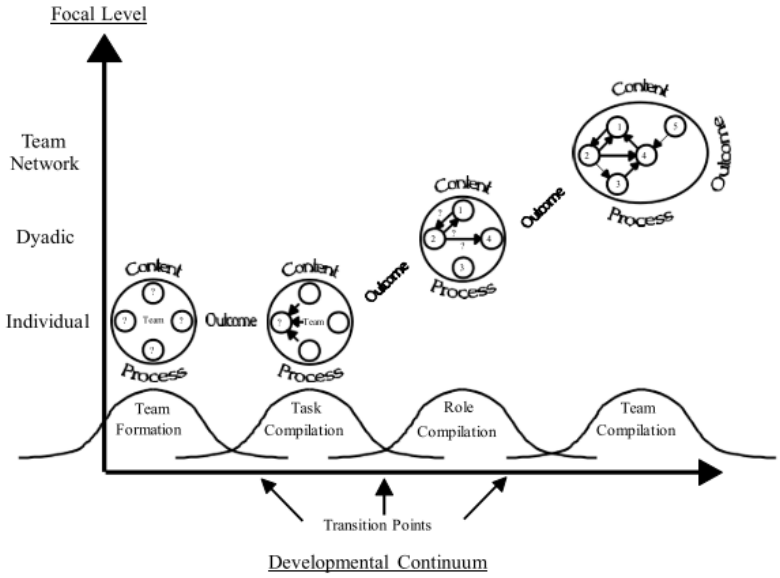


Figure 1-3: Metatheory of team development and performance compilation model (adapted from Kozlowski, Gully, Nason & Smith, 1999).

1.2.3. The team compilation model

Kozlowski, Gully, Nason, and Smith (1999) proposed a metatheory of team development and performance model—the *team compilation model*, which consolidated the perspective of performance progression and multilevel issues with the discussion of team development. In this normative model, different levels of team performance and adaptability are seen as outcomes of a continuous and dynamic developmental process in different task episodes. A single phase of task episode and developmental process can be both linear and cyclical in terms of time while the improvement of team capabilities promotes the transition from one phase to the next which is more advanced in terms of skill acquisition (Kozlowski, Gully, McHugh, Salas & Cannon-Bowers., 1996a; Kozlowski, Gully, Salas, & Cannon-Bowers, 1996b). Each transition shifts the attention to new learning content with new processes of skill and knowledge acquisition. The outcomes of a phase represent the newly acquired capabilities. As the skills, knowledge and performance outcomes accumulate and synthesise from the individual level to the dyadic and then to the team level, a team compilation phase thus emerges as a multilevel phenomenon (see Figure 1-3). In this model, there are four phases each with their own unique content, process and outcomes. The transition from one phase to the next is not considered as a discontinuous shift, but rather, a

reorientation of focus. The first phase is *team formation* in which an individual socialisation process (the process in Figure 1-3) plays a central role as members are focused on finding their fit in a new social space (the content). The outcomes of this phase include interpersonal knowledge and team orientation which serves as a shared ground for common norms, goals, and climate perceptions. The successful acquisition of such interpersonal knowledge and team orientation facilitates the transition from phase one to phase two: *the task compilation*. In this phase, individuals focus on acquiring task knowledge which is a skill acquisition process that yields task mastery and self-regulation skills as outcomes. In so doing, a team transitions to the third phase, the *role compilation*. In this phase, the level of focus shifts from the individual to a dyadic exchange, i.e. that of role negotiation. The outcome of this phase is the allocation of key roles and the identification of routines which serve to guide task-driven interactions. The fourth phase is *team compilation*, in which the level of focus shifts to the team. Through the process of creating a flexible network with interdependent roles, the outcome of a successful phase four would enable the emergence of a team unit with the abilities of continuous improvement and adaptability in facing future demands that is novel and challenging. It is worth noting that this metatheoretical model is not a time-limited model and regards the team compilation phase as ongoing, rather than the finish or end-point of team development.

The team compilation model describes the process of how a collection of individuals become a collective entity which can be defined as a team capable of carrying out the commissioned tasks and taking up unpredictable challenges. Specifying the level and orientation of skill and knowledge acquisition at each phase of the process, the team compilation model postulates a set of desirable interaction-related behaviours of members that are available to assessment and manipulation. In other words, the metatheory of team compilation facilitates team research in terms of construct theorisation and operationalisation. The concept of CZPD (the collaborative zone of proximal development), which is detailed in Chapter II is developed based on the framework of team compilation. Although team compilation model takes all four critical conceptual foci of teams into consideration, the discussion focuses primarily on member interactions. However, team phenomena concern also the collective affects and perceptions of members

that emerge, fluctuate, stabilise, diverge, converge and declines. To better understand the dynamic processes of team level phenomena, the discussion now turns to Multilevel Theory.

1.3. Multilevel theory of the teams

As is discussed in the previous session, the IMOI model advanced our knowledge of team effectiveness through the recognition of the three essential elements in the dynamic process of teams: the temporal dynamics, the multilevel structure and a rich array of mediators and outcomes as processes. The team lifecycle models, especially the metatheory of team compilation, provides a template of observable interactive behaviours ideal for the establishment of a coherent and effective multilevel hierarchical entity. However, neither of these two perspectives offer a close look at the dynamic processes of emergence in a team. To understand how various elements interact and come into play in the complex processes of emergence, it is helpful to first turn to a discussion on the complexity theory of self-organising entities (e.g. teams), which together with general systems theory, give birth to the Multilevel Theory.

1.3.1. What is emergence?

According to Weaver (1948), in complexity science, there are two distinct categories, namely the complex and the not-complex. Simple systems and disorganised complex systems are classified as not-complex systems. Simple systems can be characterised by detailed rules, a limited amount of interaction and their behavioural patterns can be predicted with great precision. Examples of such systems include trajectories, orbits, etc. Astronomical phenomena, weather and other events that operate with countless variables, or parts are defined as disorganised complex systems. However, both simple systems and disorganised complex systems are understood based on the assumption that the universe is given and governed by fixed laws. Their operations are mechanical and can be understood by an input-output process, which can be analysed by probability techniques. In brief, they can be understood as the sum of their parts.

Complex systems, on the other hand, emerge from the interaction of their agents who are capable of adapting and learning new responses to internal and external shocks. In other words, they "change their operation through operating" (Davis & Simmt, 2003). As a result, the behavioural pattern of a complex system is not easily predicted. Examples of a complex system include a microorganism, biosphere, evolution of culture and human collaboration. Phenomena such as these are termed as organised complexity or emergence in Weaver (1948). Emergence, defined as the rise of a self-organizing and self-adapting complex system, has become a research focus in the contemporary framework of complexity science. Incidences such as the spreading of ideas and the evolutionary process of cultural collectives and group collaboration are all examples of emergence. Agents in an emergent incident form spontaneously into functional collectives. The emergence of self-organised micro-behaviour can be categorised as bottom-up events depending on local adaptive laws, rather than laws driven from the top-down or those that are merely imposed. This is similar to the theorisation of IMOI, which contends that in a work team, bottom-up effects stem from the interaction on the individuals level upward to a team level. Therefore, these types of self-organizing and self-maintaining phenomena cannot be represented by the sum of individual actors and therefore cannot be analysed by cutting them into parts. As a result, through the appreciation of ever-changing operational rules and the recognition of emerging collectives, the methodological design of an emergent phenomenon requires a shift in attitude. Accordingly, the study of emergent states in a system requires the use of complex systems framework that allows for the theorisation and operationalisation of emergent constructs at different levels of analysis. As a result, the complex model of the Multilevel Theory was developed to help researchers to first, conceptualise the level of emergence and its nested nature and second, as a means of construct operationalisation (Coultas Driskell, Burke, & Salas., 2014).

1.3.2. The Multilevel Theory and the emergence of team level phenomena

Team processes are multilevel and dynamic in nature (Cronin, 2015). In his recent review of the science of team process, Kozlowski (2015) commented that research on team dynamics had seen a shift from the traditional IPO (input-

process-output) approach to a multilevel approach. Criticising the IPO approach as being "frozen" or static and ignorant of the emergent processes of group phenomena, Kozlowski (2015) called for a shift in focus from meso-level (team-level) science to a multilevel approach, which he explains as a meta-theoretical framework rather than a substantive theory. Davis and Simmt (2003) echo this claim, arguing that complexity science can be seen as a meta-discourse that lends itself to the theorization and analysis of phenomena that concern multiple levels or aspects. Multilevel theory, with its origins in systems theory and complex systems dynamics (Kozlowski et al., 1996; Kozlowski et al., 1999; Kozlowski & Klein, 2000), enables organisational researchers to position and interpret their work from a multilevel perspective such as dynamic human entities (or systems). The Multilevel Theory is not a new conceptual framework of team science (Roberts, Hulin & Rousseau, 1978), however, due to theoretical and methodological limitations, it has come to the fore with the burgeoning of the studies in team effectiveness (Kozlowski, 2015).

Multilevel Theory proposes meso-level (team-level) phenomena differ in their degree of dynamics. Based on the meta-theoretical framework of multilevel theory, Cronin, Weingart, and Todorova (2011) categorised group-level phenomena into three types with decreasing magnitude of dynamics, namely the *emergent*, *the cumulative*, and *the contextual*. *Emergence* in teams was defined in Kozlowski and Klein (2000) as that which "*...originates in the cognition, affect, behaviours, or other characteristics of individuals...amplified by their interactions, and manifests as a higher-level, collective phenomenon*" (p. 55). This articulation concurs with the argument of Morgeson and Hofman (1999) that emergent phenomena, such as team member exchange, conflict, trust, psychological safety and group identification, are seen as truly dynamic and multilevel constructs that only come into existence with elemental or individual interactions. Because individual affect, perceptions and characteristics that give rise to team level or organisational level emergent phenomena are dynamic in themselves and could change in pace among different members, emergence is seen as the most dynamic type of higher-level phenomenon (Cronin et al., 2011). Because the formation of higher-level phenomena unfolds over time, emergence is also sensitive to temporal changes. Indeed, the majority of group phenomena could be classified

as emergent (Ilgen et al., 2005; Kozlowski & Bell, 2003). However, emergence has rarely been investigated directly in team-level research (Kozlowski, 2012; Kozlowski & Chao, 2012). Instead, emergence has primarily only been assumed to justify the convergence of group member perceptions in conceptual composition designs (Cronin et al., 2011). In other studies, emergence has mostly been treated as latent, a mere inference grounded on cross-sectional single-level data (Kozlowski, 2015).

Cronin et al. (2011) regard cumulative phenomena as the additive property of individual-level characteristics such as age, tenure, IQ and functional background etc. Cumulative constructs are argued to be multilevel too as they come to existence only after the collective is formed. Therefore, there could be implications of cumulative phenomena in within-team dynamics such as the composition of demographic or role heterogeneity (Kozlowski, 2015). However, as a summary of relatively stable individual characteristics within a team, the cumulative structure should be regarded as having a minimal level of dynamics only brought about by incidences such as member changes or the gradual and predictable passage of time (Cronin et al., 2011).

Contextual elements or global properties defined in Kozlowski and Klein (2000) refer to unit-level characteristics imposed by external forces, such as, member composition, task interdependence structure, team location and intergroup competition (Baer, Leenders, Oldham, & Vadera, 2010; Menon & Phillips, 2010; Van der Vegt, de Jong, Bunderson, & Molleman, 2010). Contextual phenomena are the most static and should not be seen as products of group dynamics; however, alterations in contextual phenomena could have a direct influence on team processes and are therefore often treated as higher-level constructs acting as moderators between antecedents and outcomes (Kozlowski, 2015).

1.3.2.1. The dynamics of emergence

Considering the changing nature of emergent phenomena, the conceptualisation of multilevel constructs necessitates the attempt to capture its

dynamics. This is especially important considering that even after formation and manifestation, an emergent property continues to change and fluctuate (Kozlowski, 2015). In line with this reasoning, Kozlowski (2015) proposes a continuum of emergent property dynamics with a convergence at one end and a divergence at the other. Convergent forms of emergence describe a gradually homogeneous pattern of interest derived from the sharing of affect, behaviour and knowledge, as a result of the interaction between individual members. Convergent processes are characterised by commonality, similarity and sharing. Typical composition constructs include team cohesion, collective affect, etc. Divergent dynamics or compilation forms, on the other hand, describe the development of heterogeneity or variability of a team level property emerges through member interactions over time. Knowledge specialisation and role differentiation are typical manifestations of divergent dynamics. Team conflict is one of the most common compilation forms that could emerge over time in a collective.

The configuration of emergence could thus be theorised, measured and modelled in terms of within unit variability. However, that is not to say that a composition form emerged from individual interaction can only stay as convergent dynamics, which is a static view of team dynamics. The emergence configuration could well travel along the continuum of emergent dynamics, in other words, a dynamic phenomenon could transform from convergent to divergent overtimes and vice versa. For example, a project team might comprise of individuals with distinctive skill sets and expertise, therefore the team knowledge dynamics start as being divergent and heterogeneous, which is a compilation form. However, over time, team members learn from each other, and a dynamic of compilation might develop into a composition. As the project develops and the roles become more focused and fixed, the shared knowledge becomes specialised and fragmented once again.

1.3.2.2. The many shapes and forms of emergence dynamics

According to Kozlowski (2015), the team process dynamics can be classified into three types focusing on (a) the stability of within-team variability; (b) growth trajectories and, (c) fluctuations over time. To operationalise a team level

construct, it is a common procedure to first measure the degree of within-team variance of the construct with an index of agreement or inter-rater reliability (IRR and ICC indicators are discussed in detail in Study 4). This index determines whether the level of variance within a team is low enough to indicate the emergence of a composition phenomenon. Specifically, while the within-unit variance is lower than the between-unit variance, an emergent property of a team manifests itself as a shared (convergent) phenomenon such as a shared team efficacy or a shared team mental model. As the within-unit variance increases, this shared property starts to diminish and regresses to an individual level construct once the within-team variance is indistinguishable from the between-team variance. If this within-unit variance continues to increase after this point, a compilation (divergent) configuration of a construct emerges, such as team conflicts or a dispersion model of team efficacy. It is worth emphasising here that a dispersion model argues that considering only shared properties of a construct disregards the explanatory power of the within team variability. Granted, as is suggested by the IMOI model, the magnitude of a unit-level property is related to team effectiveness, a divergent configuration of a phenomenon that emerged for different reasons and in a variety of patterns also influences team effectiveness beyond and independent of magnitude. The sources of dispersion or heterogeneity of opinions could be the formation of a clique or cliques within a team, or differences in perception of stress or workload as a result of differences in responsibilities, or a diversified background etc. For example, as a measure of the degree of agreement within a unit, a within-team variability index can also be used as "*a substantive characteristic to index the extent to which a composition construct has emerged*" (Kozlowski, 2015; p276). For example, ICC as a common index of agreement that can also be used as a measure of the effect size of a composition construct over time and also used to test the stability of the within-team variability of an emergent property (Cole, Bedeian, Hirschfeld, & Vogel, 2011).

One pattern of team dynamics is a convergent linear emergence where multiple assessments of a team construct demonstrate a continuous monotonic increase in the degrees of within-team agreement/variability over time as is illustrated in Figure 1-4a. A team-level property is considered to have emerged

while an adequate level of convergence is achieved. This happens when member interactions result in a stable increase in the level of homogeneity --- a convergent phenomenon manifests itself. Conversely, a high level of within-team variance is an indication that a unit-level convergent construct has not emerged.

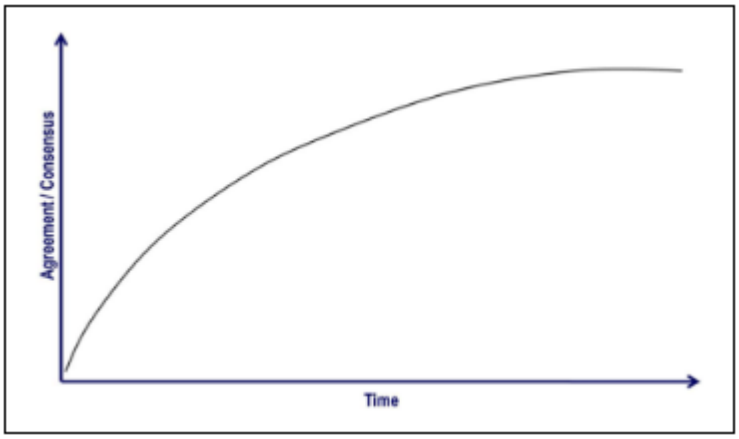


Figure1-4 a: Convergent linear emergence (adopted from Kozlowski, 2015).

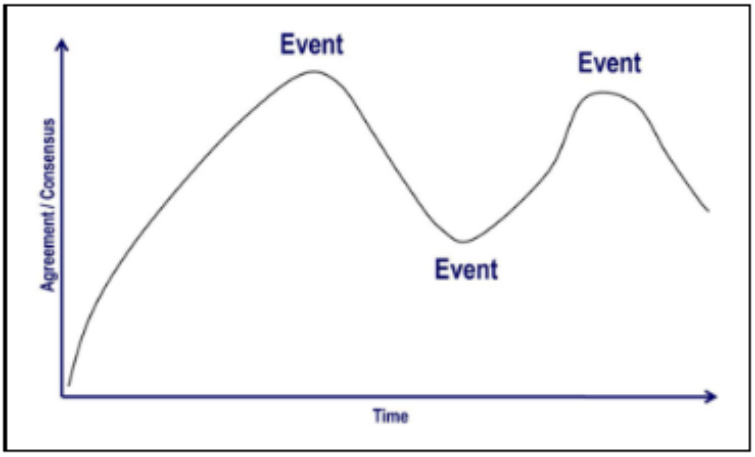


Figure1-4 b: Within-team variability in emergence (adapted from Kozlowski, 2015).

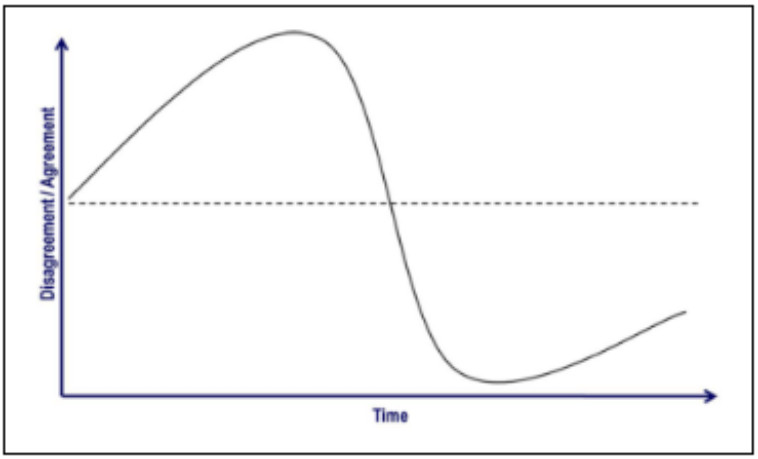


Figure1-4 c: Shift from convergent to divergent emergence (adapted from Kozlowski, 2015)

The second pattern of emergent dynamics, as is illustrated in Figure 1-4b, is characterised by an unstable reading of within-team variance over time. After emergence, a team level property might become less homogenous as the within-team variance increases due to, for example, a disparity in the experience of stress or pressure among the members. This decrease in the agreement could later revert to an increase after the stressor is removed and a high level of homogeneity of experience emerge again. Emergent properties of a team are under the influence of external and internal "shocks" and therefore fluctuate. The third pattern of emergent dynamics measured as the variability of within-team variance levels is similar to the second one but more dramatic. As is illustrated in Figure 1-4c, the "shock" triggered decrease in agreement persists after a composition property of a team regresses to an individual level construct and continue until a compilation phenomenon emerged (Brown & Kozlowski, 1999; Kozlowski & Klein, 2000). This pattern is indicative of fragmentation in opinions and/or experiences among team members. Considering the Team Compilation Model discussed above, it is possible that after a team has achieved team compilation, it could revert to role compilation or even task compilation where communication is restricted at a dyadic level. For example, an incident could set off a polarisation of experience or opinions in a team and a homogeneity becomes heterogeneity over time. Such a divergent configuration might last, or a convergent dynamic might emerge again.

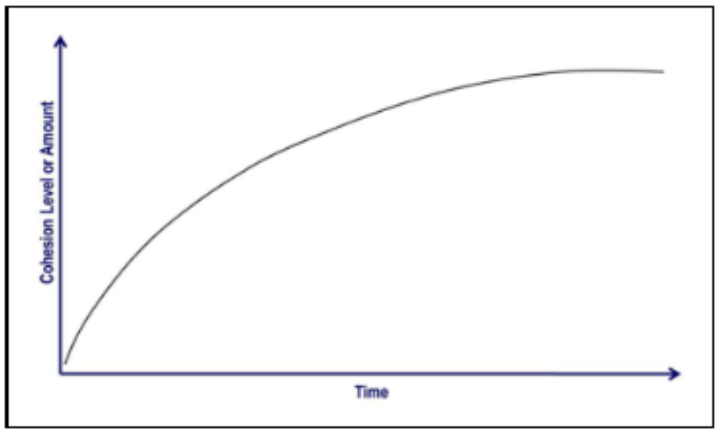


Figure1-5a: Positive growth trajectory in the level of an emerged property (adapted from Kozlowski, 2015).

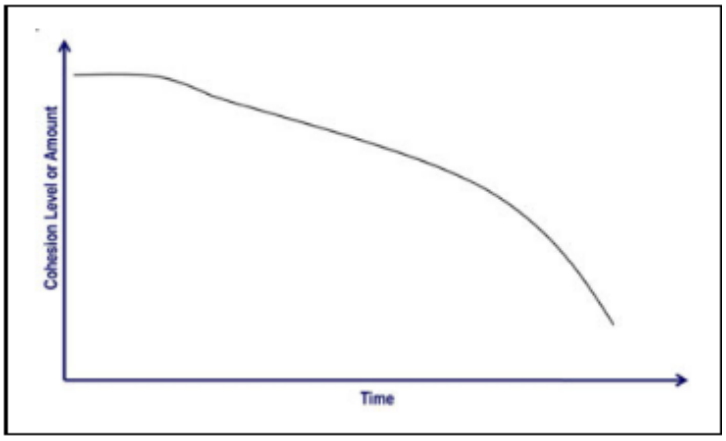


Figure1-5b: Negative growth trajectory in the level of an emerged property (adapted from Kozlowski, 2015).

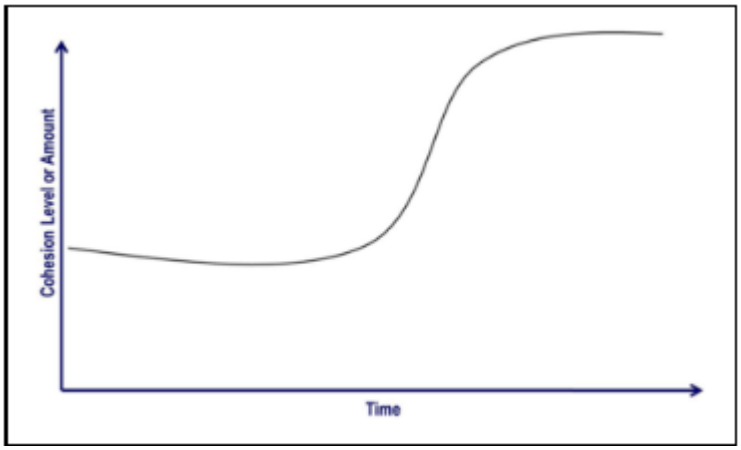


Figure1-5c: Discontinuous shift in the level of an emerged property (adapted from Kozlowski, 2015).

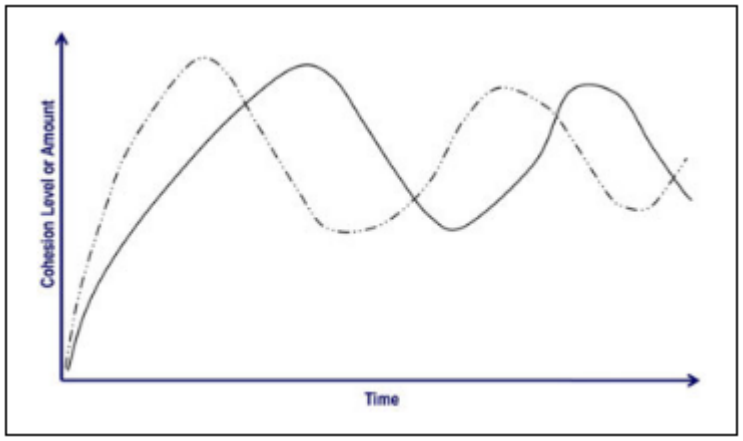


Figure1-5d: Entrained cycles in the levels of emerged properties (adapted from Kozlowski, 2015).

The following four types of dynamics are growth trajectories of already emergent phenomenon distinguishable by the variances in the magnitude of a

collective phenomenon. Figure 1-5a illustrated a positive growth trajectory where the amount of an emerged property of a unit continues to increase in a linear fashion. Consider collective cohesion as an example, it is commonly observed that the magnitude of collective cohesion tends to have a monotonous increase in a well-functioning team. In contrast to this, Figure 1-5b simply demonstrated a negative growth trajectory with a linear decrease in the magnitude of a collective construct. For example, a well-functioning team might lose its level of cohesion gradually over ineffective communication. A discontinuous shift in the magnitude of a convergent phenomenon as illustrated in Figure 1-5c can be observed typically in teams that have undergone team-building interventions after which a moderate level of collective property increases in magnitude. Finally, Figure 1-5d shows a cyclical fluctuation in the amount of a unit level phenomenon. Subjected to a constant change in the external environment and task demands, teams working in isolated, confined and extreme (ICE) conditions such as in the International Space Station and polar areas, for example, are observed to operate in a cycle in the magnitude of emerged properties (Pearce, Rench, Braun, Baard, DeShon, Kozlowski, 2012). In the same sense, considering the IMOI model, a reciprocal relationship between the output of a team and its emerged mediational properties could also produce such a cyclical fluctuation in the magnitude of an emerged phenomenon (Kozlowski, 2015). Changes in the magnitude of a unit-level phenomenon make a variety of dynamic trajectories possible in a team's life span.

The discussion on the process of emergence and the dynamics of emergent properties of teams facilitates the conceptualisation and operationalisation of team-level constructs. As this research aims to develop team effectiveness by testing a model concerning the relationships between team-level constructs, which are the result of individual interaction and are all considered as the most dynamic, a thorough understanding of team dynamics forms a solid ground for research.

1.4. Chapter summary

As is stated in the overview of this chapter, this research aims to investigate the nature and relationships between team-level constructs in the hope to develop

a tool to enhance team effectiveness. Therefore, this chapter began by reviewing the current literature about teams. Based on the four research foci proposed by Kozlowski & Bell (2013), this chapter reviewed three contemporary team science theories, the Team Effectiveness Framework, Team Lifecycle Theories and the Multilevel Theory. Through these three distinct yet complementary lenses, this chapter has sought to provide a comprehensive theoretical understanding of teams in the workplace. The IMOI framework of team effectiveness scaffolds the postulation of the relationships between team-level constructs. Team lifecycle theories, specifically the team compilation theory, prescribes a series of desirable behaviours that promote the establishment of a team step by step, grounding the emergence of latent team constructs into tangible behavioural indicators which provide a basis for the conceptualisation, operationalisation and design of interventions. The Multilevel Theory provides a high-fidelity, up-close look at the convergence and divergence of team processes and mechanisms emerging in a multilevel structure through team members' interdependent operations of collaboration and coordination over time, thus enabling the careful operationalisation and conceptualisation of emergent events. As IMOI assumes that all relevant constructs have emerged at the team level, Multilevel Theory, therefore, makes up for its ignorance of the convergence, divergence and fluctuation of emergent events, giving a full account of the processes. Team lifecycle theories specify the interactive behaviours necessary for a team to establish, thus adds to the comprehensiveness of the big picture of team phenomena and their interrelationships.

Taken together, the above-mentioned theories build a solid and comprehensive framework for the theorisation and operationalisation of the focal team-level constructs of this thesis. Building on this framework, the next chapter will introduce the team-level constructs of team flow, team efficacy and the collaborative zone of proximal development (CZPD) in turn and then discuss the hypothesised psychological and behavioural resources model of team flow (PBrTF).

CHAPTER II: TEAM FLOW AND ITS PSYCHOLOGICAL AND BEHAVIOURAL RESOURCES

2 overview

Based on the theoretical perspectives offered on teams and the multiple criteria for team effectiveness discussed in Mathieu and Gilson (2012), the next chapter introduces three team-level phenomena, team flow, team efficacy and collaborative zone of proximal development, as focal constructs of interest of this thesis. All three constructs have been identified as the most dynamic of meso-level emergent constructs relevant to the enhancement of team effectiveness. As these emergent phenomena have been deemed as the most dynamic and sensitive to internal and external "shocks"—the influences forced on a complex system, they are proposed to be the most malleable and responsive to interventions. Moreover, considering the potentially reciprocal relationship between team-level emergent phenomena proposed by IMOI, interventions designed to change such elements in teams can be cost-effective because investment made to change one variable could bring about an improvement in other related aspects too. As such, these serve as an ideal starting point for the design of interventions that enhances team effectiveness.

This chapter starts to introduce the three team-level phenomena in interest. Through the lens of the Social Cognitive Theory (Bandura's (1977, 1986)) and the Broaden and Build Theory (Fredrickson, 1998, 2003, 2004), the final section of this chapter integrates the theoretical debates to identify the research objectives of this thesis.

2.1 Flow

2.1.1 The psychic compass for a continuous improvement

Four decades ago, the research into the state of complete immersion or the optimal state of intrinsic motivation, which was subsequently termed flow, was coined by Mihaly Csikszentmihalyi (1975; p.36) who proposed that flow is a "*holistic sensation that people feel when they act with total involvement*". According to Nakamura and Csikszentmihalyi (2009), the cognitive evaluation of everyday life activities can be modelled into eight types in terms of their configurations of skill-challenge balance; these are flow, arousal, anxiety, worry, apathy, boredom, relaxation and control. This is the Channel Model of Flow (Csikszentmihalyi, 1975, 1990).People are happiest and most concentrated while in flow. In a interview, Csikzentmihalyi defines flow as "*being completely involved in an activity for its own sake. The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you're using your skills to the utmost*" (Geirland, 1996). Using experience sampling methods, Csikszentmihalyi (1997) discovered that, compared to time spent in leisure activities, people are more likely to experience flow at work. It is said that, instead of flow, people tend to feel bored during their leisure time, particularly when if they engage in passive unstructured activities such as watching TV programmes. This finding indicates that, in order to experience flow, a state of streamlined concertation, weakened self-consciousness and altered sense of time, one needs to exert effort. In other words, an investment in time and energy in facing up to challenges is necessary for the experience of performing at the peak of one's ability. As Orin C. Davis stated in the 9th positive psychology conference: "*flow is a struggle*" (Davis, 2018), a hyper-concentrated state of mind snatched by the immediate challenge. Over and above challenge, research also shows that in order to induce flow, the perception of a balance between skill and challenge is the key precursor (Clarke & Haworth, 1994; Csikszentmihalyi, 1990; Massimini & Carli, 1988). With challenge exceeding skill level, anxiety pervades, and when skill exceeds challenge, a sense of boredom develops. Accordingly, the state of flow is a subjective experience of optimal performance in which the individual is absorbed in a state of intense mental concentration or a physically challenging activity that is a close match with his/her skill set (Csikszentmihalyi & LeFevre, 1989). Csikszentmihalyi (1990) speculated

that in flow, an individual is captured in a state characterised by the merging of awareness and application in which he or she perceives a sense of control and an autotelic experience (i.e. intrinsic motivation: doing something for the sake of the process) accompanied by the loss of self-consciousness and the transformation of time. The feeling of enjoyment and happiness in flow is posited to derive from the intrinsic motivation in the involvement of the activity rather than any extrinsic reward promised. Flow has thus been seen as an insightful concept in explaining self-perpetuating working or playing behaviours (Quinn, 2005).

The above description emphasised two main characteristics of flow: the balance between skill and challenge, and intrinsic motivation for self-actualisation. Bassi and Delle Fave (2004) explains that flow signifies a well-defined configuration of consciousness with intrinsic stability and a precise structure. This configuration represents a *psychic negentropy*. Unlike *psychic entropy* which refers to a disordered consciousness filled with conflicting goals and expressions of fear, boredom and apathy, *psychic negentropy* is a harmonious state of the content of consciousness, in which "*thoughts, intentions, feeling and all the senses are focused on the same goal, and experience is in harmony*" (Bassi & Delle Fave, 2004, p47). Csikszentmihalyi and Csikszentmihalyi (1992, p24.) claim that "*because the tendency of the self is to reproduce itself, and because the self is most congruent with its own goal-directed structure during episodes of optimal experience, to keep on experiencing flow becomes one of the central goals of the self*". Ceja & Navarro (2009), Delle Fave (1996), Guastello, Johnson, and Rieke, (1999) thus regard flow as an *attractor* of consciousness, around which the evolution of the dynamics of consciousness is centred. This gravitational pull of flow drives the self to repeatedly engage in activities that one perceives as high in challenges which match with one's skills. This pursuit of optimal experience leads to better performance and gradual and continuous development of skills and competencies because, as one masters a level of skills, the corresponding demands stop being challenging, interesting and stimulating. In order to avoid boredom and repeat the optimal experience, one is intrinsically motivated to deploy available personal resources to tackle a higher level of challenge. Thus, a positive loop that feeds the need for self-actualisation and fulfils a constant desire for growth, learning and development is mobilised around the attractor of flow. As

Csikszentmihalyi (1990; 1993) argues, the intrinsically dynamic, complex and positive experience of flow can thus be seen as a "*psychic compass*" that navigates oneself through life to build a unique life theme.

A recent development raised an issue regarding the Channel Model of Flow (Csikszentmihalyi, 1975, 1990). As is mentioned earlier, the Channel Model of Flow mapped everyday experience to eight types based on different configurations of the skill and challenge ratio (Csikszentmihalyi, 1990; Massimini & Carli, 1988; Moneta & Csiksentmilhaly, 1996). An optimal subjective experience, or flow, would be induced by engaging in an activity that is characterised with a balanced between a high challenge and high skill situation. However, Lamber, Chapman and Lurie (2013) pointed out that the Channel Model of Flow failed to consider the type of activities with a moderate level of skill and challenges. Therefore, based on the experience fluctuation model (EFM), Carli, Delle Fave, & Massimini, (1988) Clarke & Haworth (1994) posit that apart from the flow channel, there is a control channel in which a high level of skill is combined with a moderate level of challenge. Carli et al. (1988) finds that people report the highest level of positive affect and motivation in the control channel and in the flow channel, people tend to perceive a higher level of cognitive efficiency, interest and activation. Interestingly, Clarke and Haworth (1994) and Moneta and Csikzentmihalyi (1996) finds that challenge is positively associated with interest, concentration but negatively connected to happiness, enjoyment, and engagement. Ergo, Lamber et al. (2013) suggests that the control channel model with moderate challenge level is more predictive of positive affect and intrinsic motivation while the flow channel model with a high level of challenge is more associated with cognitive efficiency and extrinsic motivation.

2.1.2 Nine dimensions of flow: the antecedents, the scaffolds and the core

According to descriptions from the interview participants of Csikszentmihalyi (1975), *flow* describes a state of a "*feeling of fluidity and continuity in concertation and action*". *Optimal experience* is the corresponding "*pervasive positivity of cognitive, emotional, and motivational features*" that can be characterised into a nine-element model, which include; (1) clear proximal

goals; (2) immediate feedback of performance; (3) balance between one's skill and challenge; (4) control (or free from worries of failure); (5) concentration (or distractions excluded from consciousness); (6) intrinsic motivation (or autotelic experience); (7) disappearance of self-consciousness; (8) distorted sense of time; (9) merging of action and awareness) (Csikszentmihalyi & Csikszentmihalyi, 1992; Csikszentmihalyi, 1975, 1990; Nakamura & Csikszentmihalyi, 2009). Flow scholars have since modified this model, distinguishing these elements into antecedents, scaffolds and core components (van den Hout, Davis, & Swlrave, 2016). The first three elements are seen as external preconditions or antecedents of flow experience (Hamilton & Hurford, 2007; Quinn, 2005). Intrinsic motivation, control and concentration are termed as scaffolds of flow acting both as (1) the perceptual antecedents that can be fostered internally by the individual and then enable the core experience of flow; (2) and the indicative components of flow experience (Hamilton & Hurford, 2007; van den Hout et al., 2016). The last three elements are classified as flow components that characterise the core of the flow experience (Landhäußer & Keller, 2012; Quinn, 2005). A Rasch Model testing the difficulty levels of a 36 item flow questionnaire corresponding to the 9 optimal elements of flow supported this proposition, demonstrating that the items from the three dimensions of the core flow experience indeed show more difficulties and are less prevalently experienced by participants (Tenenbaum, Fogarty, & Jackson, 1999). It is of great practical importance to distinguish between antecedents, scaffolds and the core of flow in order to facilitate the occurrence of a flow experience. Of the nine elements, the three antecedents, as external elements, are the most accessible for manipulation. The scaffolds are both the result of the successful instalment of the antecedents and a gateway to the core of flow---the most profound state of flow experience. In other words, elements of the scaffolds, i.e. intense concentration, control and intrinsic motivation, are the early signs of flow, transmitting the external influences on the internal core of flow experience. However, interventions targeted at the scaffolds are less effective and attempts made to directly manipulate the core elements of flow often backfire, resulting in experiencing the exact opposite of a core flow state – the *psychic entropy* (Csikszentmihalyi, 1997; Delle Fave, Massimini, & Bassi., 2011). Therefore, flow interventions are most effective targeting at creating and nurturing the three flow antecedents.

Accordingly, this project will focus on building team resources to nurture the flow antecedents in order to facilitate the emergence of the core team flow experience. The following sections will discuss team flow in detail.

2.2 Team flow--A contagious shared property and a possible indicator of peak team performance in project teams

Team scholars were inspired by these observations, which catapulted research into collective flow seeing that collective flow indicates not only the possibility of collaboration at the peak of team capability, but the likelihood of a positive impact on individual well-being (Eisenberg, 1990; Hatch, 1999; Levitt, 1996; Murninghan & Conlon, 1991). If it is possible for an individual to organise his/her normally scattered attention and enter into an intense state of concentration or the psychic negentropy, so could a group of collaborators (Armstrong,2008; Sawyer, 2014). Keith R. Sawyer, an expert on team performance and collective creativity, who began his research on team flow two decades ago, observed that team flow does exist at a collective level and shares similar psychological processes with the individual flow. Sawyer proposed that team flow is "*a collective state that occurs when a group is performing at the peak of its abilities*" (2014; p. 167). With the collective perception of balance between skill and challenge at the group level as an essential element, Sawyer posits that team flow might be more likely than individual flow. Explained in Bakker, Oerlemans, Demerouti, Slot, & Ali (2011), as a team level psychological state, team flow is shared among group members who are interdependent of each other and involved in the same working experience via the mechanism of the Emotional Contagion (Elfenbein, 2014).

Similarly, Schiepe-Tiska and Engeser (2012) describes that the experience of flow can be "infected" from one member to another and that the effect of emotion contagion becomes more profound as the size of the team gets bigger. A study comprising a survey and two experiments by Walker (2010) demonstrated that social flow is rated as more enjoyable than flow experienced in a solitary state, especially involving tasks requiring a high level of interdependence. Although what

Walker (2010) studied is not strictly speaking team flow, but a shared social flow at the individual level (more to this in the later section), the enjoyment felt was triggered by the social context—the collective, which generates feelings and thoughts that are qualitatively different (Lewin, 1952).

Integrating the extant view of team flow, van den Hout, Davis, & Walrave, (2016) postulated a comprehensive model that describes the quality of team flow. In their view, the team flow experience encompasses the following five components: shared identity; a sense of unity; trust; a sense of joint progress; and holistic focus. (1) Shared identity or collective ambition is formed by a shared collective intrinsic motivation and thus constitutes the very reason for the existence of the team. Shared value and knowledge of complementary skills build up the shared identity, which leads to interpersonal flow (Snow, 2010). (2) A sense of unity: a shared sense of unity is established while members' personal goals are aligned with the common goal of the team. A sense of unity is consistent with the notion of the loss of self-consciousness (Csikszentmihalyi, 1990) as well as Sawyer (2007)'s claim of a true blending of egos within a team. (3) Trust: a shared trust of the collective capability to accomplish the task, which resembles the notion of collective efficacy (Salanova et al., 2014). Established through the fulfilment of the preconditions of open communication and the sense of safety, trust invests confidence among members to try out new ideas without fear of failure and a willingness to depend on one another. (4) A sense of joint process: a collective knowledge of making joint progress towards the common goal and personal goals. (5) Holistic focus: a collective focus on team collaboration to reach a common goal. This holistic focus is the outcome of members' mutual commitment towards the shared common goal. From a behavioural perspective, based on Condon (1986)'s theory of entrainment, Armstrong (2008) equates team flow with the synchronisation of body language, which implies a collective perception of togetherness. For example, people collaborating coherently often mimic each other's gestures or facial expressions and repeat each other's words and opinions (Gordon-Calvert, 2001). Fusaroli and Tylén (2016) argue that from a psycholinguistic perspective, interactive alignment, like reciprocal behaviour and physiological mimicry, is closely related to the sharing of common ground, strengthened rapport, and improved collaborative performance.

As one of the pillars of the positive psychology movement, flow has long been identified as an important contributing factor in enhancing performance and well-being for both the individual and the team. For example, Bakker (2008) finds that flow at work is positively associated with job satisfaction. Fullargar and Kelloway (2009) discovered a unidirectional causal relationship between workplace flow and positive mood. Exposure to flow induces positive moods, but positive moods do not predict flow at work. Performance, both in- an extra- role, was found to be another important result of optimal experiences among conscientious workers (Demerouti, 2006). Eisenberger, Jones, Stinglhamber, Shanock, & Randall (2005) found that employees working in high-challenge high-skill positions tend to engage in extra-role performance behaviours such as providing constructive feedback or investing in developing one's skill and knowledge to assist the organization or their co-workers. In a social context, Walker (2010) emphasises a reciprocal relationship between a shared form of flow and team cohesion and high competency. Aubé, Brunelle, & Rousseau (2014) observed that individual-level flow in work teams is positively related to team performance. Admiraal, Huizenga, Akkerman, and Dam, (2011) also documented that higher-level flow aggregated from individual flow experience predicts performance in collaborative gameplay. Bakker et al., (2011) demonstrated that team flow is positively related to team performance. Considering the abundant evidence in the literature, it is sensible to consider team flow as one of the concept with in the multifaceted umbrella framework of team effectiveness. Moreover, team flow is specifically suitable as an indicator of team effectiveness for project teams. As mentioned in the previous chapter, one of the characteristics of a project team is product uniqueness, which requires a drive to pursue continuous learning and improvement which team flow undoubtedly promotes and facilitates.

2.2.1 The conceptualisation and operationalisation of team flow

2.2.1.1 The many forms of flow

The definition of team flow, although theoretically based on individual flow, has not reached consensus among team flow scholars, and there is much confusion in the terminologies used in the literature. The extant literature identifies flow as an individual psychological phenomenon as well as a collective emergent psychological phenomenon (Sawyer, 2003, 2014), which is often termed as group flow or team flow. Flow of different forms and levels have been studied using a variety of terminologies, for example, 'group flow' by Armstrong (2008), Hart and Blasi (2015), Salanova et al. (2014), and Sawyer (2003), 'social flow' by Walker (2010), 'shared flow' by Hart and Blasi (2015) and Salanova et al. (2014), 'collective flow' or 'co-flow' by Salanova et al. (2014), 'team flow' by Heyne, Pavlas, & Salas, (2011) and 'combined flow' by Hart and Blasi (2015). Raetting and Weger (2018) reviewed the specific definitions used in the literature and attempted to categorise these terminologies into two broad types: the individual flow, which is a psychological state of an individual, and group flow which is an emergent property of a group. On the individual level, there could be "Micro Flow" which is characterised as a shorter instance of flow experienced in noninstrumental activities such as doodling, jokes, or word grams (Graef, 1975). Jackson, Kimiecik, Ford & Marsh (1998) defines state flow as "*the experience of flow during a particular activity*" and dispositional flow as "*the typical frequency of flow experience during participation in a activity due to the individual's disposition*" (Kawabata, Mallett & Jackson, 2008; p 467). Accordingly, flow experienced alone with no one else at present is 'solitary flow'. Individual flow can also be experienced as the result of the presence of others - this is termed social flow. One type of social flow is co-active flow, which is flow experienced with no interaction with others. Conversely, another type of social flow termed as interactive flow (Walker, 2010), which describes the flow experienced as a consequence of interacting with other people. For example, a teacher may experience flow as a result of teaching and interacting with his/her students. In this case, the interactive flow experience by the teacher is a private interactive flow. If, however, the students also experience flow, the teacher and the students are in a shared interactive flow where flow is induced by the interaction, but the experience is still personal. As a type of individual flow, shared interactive flow is easily confused with group flow or team flow, which is regarded as an emergent team

level psychological phenomenon that cannot be broken down into the sum of individual flows.

In contradiction to the above, Sawyer (2007), van den Hout et al., (2016) contend that for a team to be in flow, all members must experience individual flow, in accordance with previous findings by Jackson (1995), Sato (1988) and Russel (2001). Sato (1998) describes the flow experience of motorcycle gangs in Japan. Participants from Sato (1988) reported individual flow experiences as a result of being a part of their group activity. Russel (2001) emphasized team interaction and Jackson (1995) refers to partner unity as the essence of flow experience. These studies, however, suggest the likelihood of shared social flow, not team flow. In fact, in some cases, the evidence suggests that a strong individual flow experience hinders the emergence of team flow because when one is at the height of flow, one experiences the merging of action and awareness, loss of reflection and self-consciousness, and a distorted experience of the passage of time - all of which are inwardly oriented cognitive processes that can be easily disrupted by the need for social interaction. In a small team-based airport simulation study, Baumgartner (2015) found that personal flow is detrimental to team performance possibly because the team member was '*lost to the zone of a personal task*'. The present research concurs with Sawyer's (2007) claim regarding team flow as a unique property of a team that reflects a collective cognitive process which may or may not involve individual members' personal flow.

2.2.1.2 The conceptualisation and operationalisations of team flow

Just as different types of flow have emerged, flow has been operationalised in many ways. Although derived from individual agents, team flow is not considered as the equivalent of the simple aggregation of individual flow experiences (Sawyer, 2014). Sawyer explains that it is possible for a team as a whole to be in flow while some of its members are not, and vice versa. In other words, it is not necessary for a shared team flow to coincide with members' subjective experiences of individual flow. This reasoning underlines the limitation of studying team flow using the self-report method alone. Indeed, as a collective state of intense concentration, it is hard for someone to be aware of whether they

are in flow, therefore, Armstrong (2008) argues that one way to observe and assess team flow, its emergence, qualities and fluctuations over time, is through objective observation by an outside onlooker or a member of a team reflecting on their team flow. Compared to self-report methods, observation of a group of people's conversations, gestures and use of artefacts gives access to the status of the collective mind that might not be accurately perceived by its individual members. In her study of group flow in middle school mathematics classrooms, Armstrong (2008) proposes that team flow could be observed as a series of physical or verbal synchronisations among group members. As a means to influence and maintain a social relationship, synchronisations such as these are primary and fundamental human communication behaviours that are indicative of a sense of "togetherness" or of group members being "of one mind" (Armstrong, 2005; 2008). As explained in previous chapters, flow can be spread within a team by the phenomenon of emotional contagion, which is explained in Hatfield, Bensman, Thornton, & Rapson (2014: p. 161) as "*the tendency to automatically mimic and synchronize facial expressions, vocalizations, postures and movements with those of another person and, consequently, to converge emotionally*". Thus, Armstrong (2005; 2008) goes on to propose that team flow could manifest itself as the quicker synchronisation of physical and verbal behaviours between members. These might include physical closeness; echoing of gestures and phrases; and a fragmented way of speaking where members seem to be finishing off each other's sentences. Armstrong (2008) placed emphasis on gestures and intonation of speaking as a means of spotting and recording group flow.

However, the most popular and cost-effective method of capturing team flow is still a self-report survey. By aggregating individual team members' responses to a team level, advanced statistical techniques such as multilevel modelling can make use of simple survey method while accounting for the variations of experiences in team members. It is worth reiterating that Team Flow is not a direct translation from individual Flow. Both concepts have their own definition. In p 30 section2.1.1, it is stated that: " the state of flow is a subjective experience of optimal performance in which the individual is absorbed in a state of intense mental concentration or a physically challenging activity that is a close match with his/her skill set (Csikszentmihalyi & LeFevre, 1989). The theoretical

underpinning of Team Flow is the phenomena of emergence and Multilevel theory that are discussed in section 1.3. As a form of emergent team level property, team flow is not a direct translation from individual flow, but a phenomenon emerged as a result of member interaction. This interaction can be behavioural but also cognitive and emotional. The discussion in section 7.2.2.2 details how this interaction is aggregated methodologically. Many scholars have tried to conceptualise and measure flow in such a questionnaire format. For example, Massimini & Carli (1988) framed the cognitive process of peak concentration based on the concept of the Contextual Structure of Reference (CSR), claiming that conscious attention in humans only happens during the process of conducting an activity. Jackson and Marsh (1996) developed a 36-item Flow State Scale in a sports context based on the original 9-dimensional structure of flow proposed by Csikszentmihalyi (1990, 1993). In his attempt to distinguish subjective well-being and self-actualization, Vittersø (2004) proposed the Flow Simplex. Also, the Team Flow Monitor questionnaire developed by van den Hout et al. (2016) was a direct operationalisation of their eleven-element team flow framework. The list goes on but as the number of competing theorizations increase, the additive value of the research decreases. In order to reconcile the discrepancies in the research and reach a consensus in terms of conceptualization, Bakker (2005, 2008) reviewed the extant flow frameworks and extracted three common and essential dimensions of the optimal experience compatible with the workplace context: absorption, work enjoyment and intrinsic work motivation, all of which have been commonly studied in many flow-related studies (Csikszentmihalyi, 1997; Csikszentmihalyi & Csikszentmihalyi, 1988; Csikszentmihalyi, Rathunde, &Whalen, 1993; Larson & Richards, 1994) and developed a flow questionnaire for the use in workplace, the WOrk-reLated Flow inventory (WOLF). *Absorption* describes an employee's experience of complete concentration while immersed in the work. Echoing Csikszentmihalyi (1989), in this state of total immersion, employees stop being aware of the passage of time and what happens around them. According to Diener (2000), the experience of *work enjoyment* can be seen as the outcome of a positive assessment of the flow-like experience, both cognitively and affectively. *Intrinsic motivation* is the drive to perform for an innate pleasure and satisfaction brought about by the work itself (Deci & Ryan, 1985). Later, based on Bakker (2005)'s work, Rodríguez-Sánchez, Cifre, Salanova and Åborg (2008), Rodríguez-Sánchez,

Salanova, Cifre and Schaufeli (2011) and Rodríguez-Sánchez, Schaufeli, Salanova, Cifre and Sonnenschein (2011) validated the WOLF and removed its motivation dimension, thus proposing a two elements model. They argue that absorption and enjoyment are the core psychological elements of flow while intrinsic motivation acts as a necessary antecedent. Using a confirmatory factor analysis, Salanova et al. (2014) tested and supported the two-element model on a group level, claiming that team flow partly acts as an analogous process to individual flow. Apart from being an indicator of a state of complete concentration in which employees immerse themselves, in this two-element model, absorption also encompasses the sense of losing track of time, diminished awareness of the self, reluctance to disengage from work, and as the generation of creative insights (ibid). Nevertheless, these studies have only examined the occurrence of team flow, whilst the antecedents facilitating the emergence of team flow were only assumed (Keeler, Roth, Neuser, Spitsbergen, Waters, & Vianney, 2015).

Flow does not equate to optimal objective performance, which is hard to measure as there is not a unified way of measuring performance in various types of jobs. As is discussed in section 2.1.1, the definition of individual Flow by Csikszentmihalyi stresses that Flow is the subjective experience of optimal performance. The word "subjective" here deliberately and clearly separates the latent perception of Flow existing in a person's mind and the objective performance or successes. Similarly, Team Flow, as an emergent team level state derived from members' interaction, is a cognitive and emotional team level context similar to the concept of culture and climate, although much more fragile and dynamic. Such a perception shared by team members also should not be confused as a measure of objective team performance. Sawyer's definition of team flow does not equate team flow to performance; instead, team flow is considered as a collective state that occurs when a group is performing at the peak of its abilities". Again, this emphasis that team flow, like individual flow, is a perception occurs when a team is performing at the best of its ability, but this "best" might be turn out to be mediocre performance according to an external objective criterion.

2.2.2 The antecedents of team flow at work

In the workplace context, flow was initially studied through interviews on physically challenging activities among professional athletes who reported repeated exposure to flow like experience while engaged in intensive training or competitions. Parallel to this line of inquiry, evidence was also found to suggest the occurrence of flow in creative occupations such as musicians and artists. Although not explicitly defined at the beginning (Csikszentmihalyi & Larson, 1992; Jackson & Roberts, 1992), the supporting evidence of flow like phenomena was promising enough to inspire a vast number of studies researching flow's influence on performance in the workplace. Examples include the management of knowledge and expertise in dealing with uncertainty, high performance, and workplace motivation for the skills, workplace learning, workplace improvisation and job crafting (Hatch, 1999; Kanfer & Heggestad, 1997; Mirvis, 1996; Spender, 1996; Spreitzer, Quinn & Fletcher, 1995; Wrzesniewski & Duton 2001). Quinn (2005) sampled a group of knowledge workers whose roles range from engineers, scientists, managers to technicians and found that flow experience permeates such occupations as well. Flow was also experienced in a variety of professions including managers, engineers, teachers, white- and blue-collar workers, and rescuers (Bassi, Zanella, Cressoni, Stylianou, & Kolobow, 2008; Delle Fave & Massimini, 2005). It is evident that flow is a common occurrence in the workplace.

However, the tendency of experiencing flow varies with the types of profession and with the specific type of activities carried out during work. After studying participants' descriptions of their flow experience at work and the circumstances that enabled the flow experience, Delle Fave et al. (2011) suggests that, it is true that not all professions offer an equal opportunity to experience flow and that if a job offers the opportunity to practice one's skills and competencies to tackle challenging situations, it is more likely to have satisfied workers' need for self-actualization and willingness to engage in extra-role activities. For example, managers and engineers are more likely to experience flow at work compared to clerical and assembly-line workers (Lefevre, 1988). And more often than not, optimal experience occurs during planning and problem solving, not brainstorming (Nielsen & Cleal, 2010). Delle Fave et al. (2011) sampled participants from five professions, physicians, craftsmen, white-collar workers, blue-collar workers and cashiers and observed that amongst the professions

sampled, individuals of different professions differ in their ability to register optimal experience with 91.7% in cashiers and 52.7% with blue-collar workers. Also, craftsmen are more likely to experience flow during work, physicians reported almost of an equal distribution of flow experienced in both work and during leisure, while cashiers and blue-collars found more opportunity for optimal experience during leisure time. At the team level, Bakker (2011) found that the Dutch soccer players reported more team flow after a winning match or a match with a draw, underscoring the conductive function of the skill-challenge balance to team flow. These findings are not surprising as flow in its conception has been closely associated with the perceived balance between one's skill and challenge, a state of consciousness distinct from anxiety and boredom.

Moreover, for team flow to emerge, it is also important to have consistent clarity of the collective goal so the members can orchestrate their collaboration accordingly through the different stages of team and task development. Apart from the research done using the 9-dimension FFS questionnaire developed by Jackson & Marsh (1996), the role of goal clarity in team flow is also evidenced in van den Hout et al. (2016) both conceptually and empirically. Based on Sawyer's (2007) ten group flow-enabling conditions and team research theories, van den Hout et al. (2016) devised their own Team Flow Monitor questionnaire, proposing an eleven-element model of team flow with six precursors and five components. Two of the six precursors relate to goal clarity. van de Hout et al. (2016) explains that to enable the emergence of team flow, a common goal shared by all members needs to be clear and meaningful and being internalised by all members. When this common goal is compatible with members' personal goals, it promotes member growth as well. Together with a clear goal, Csikszentmihalyi's original 9-dimensional framework also emphasises the importance of immediate feedback as an antecedent of the flow experience. For an individual to perform at his/her best, constant feedback is indispensable as it enables the attention to be centred on the task in order to make adjustments and improvements. For team flow to emerge in a work context, immediate feedback given by teammates anchors the team's attention on the collective task, drawing the collective to focus on the goal and their performance, correcting mistakes and avoiding deviations. Therefore, in line with Csikszentmihalyi's original 9-dimensional framework of flow, the

prerequisites of team flow are conceptualised as a balance of skill and challenge, a clear common goal and immediate feedback shared by all members of a team. As is discussed in section 2.1, to facilitate the emergence of the core team flow experience, interventions would be most effective if it is targeted at these flow antecedents.

2.2.3 The mutual feedback loop between the resources and team flow at work

Apart from individual characteristics such as conscientiousness (Demerouti, 2006), achievement–orientation (Eisenberger et al, 2005) exhaustion (Mäkikangas, Feldt, Kinnunen, & Tolvanen, 2009) and cultural differences in the perception of job-leisure division, the flow experience tendency is also largely influenced by the perception of job resources available. Job resources are defined as the physical, social or organisational resoourcs that facilitate goal achievement and stress-reduction. Typical job resrouces include autonomy, learning and development opportunitiy, coaching amd metoring etc. (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). This is reasonable because by keeping employees accountable for their work processes and outcomes and by providing feedback on their performance, job resources are motivational, and offer employees more meaning to their jobs. Most participants from the five types of profession sampled in Delle Fave et al (2011) reported that autonomy and positive relations at work as the most important job resources conducive to the flow experience. The craftsmen sampled, however, listed challenges as the most conducive. Cashiers and blue-collar workers felt that negative relationships prevented the opportunity for flow,and for physicians and craftsmen, flow was least likely when they were overloaded. There are five types of job resources identified in Job Characteristics Model: skill variety, autonomy, task identity, task significance and feedback. Based on the Job Characteristics Model measured by the Job Diagnostic Survey (Hackman & Oldham, 1975), Demerouti (2006) calculated a motivating potential score (MPS) of jobs in various companies and found that MPS was a positive predictor of flow. In addition to these five types of job resources, Salanova, Bakker, & Llorens (2006) found that professional development opportunities, an orientation of innovation, rules, and goals are all positively related to optimal experience at work. Bakker (2005) discovered that organisational resources such

as autonomy, social and supervisory support, and feedback serve as important precursors for the teacher's experience of flow at the workplace.

Conversely, flow enhances job resources. Considering the positive effects of flow for organisations such as employee motivation and well-being, cohesive collaboration, skill acquisition and enhanced in-role and extra-role performance, these outcomes all serve to enhance an organization's resources. For example, Snow (2010) found that when two people were collaborating on a shared task, a form of shared flow predicts the exchange and absorption of knowledge between the two parties, facilitating the enhancement of mutual learning and competency of a team. Apart from the relationship between flow and performance discussed earlier, Aubé et al. (2014) also found that flow is associated with goal commitment and the level of information exchange in project teams. Moreover, an upward spiral relationship between flow and personal and organizational resources (i.e. self-efficacy and social support and clear goals) was found in a group of teachers (Salanova et al., 2006), suggesting that while resources promote flow experiences, flow also helps replenish and build resources. Mäkikangas, Bakker, Aunola, & Demerouti (2010) also found a similar reciprocal relationship. Based on these findings, Salanova, et al., (2014) tested a reciprocal model between team flow and team efficacy and termed it the Extended Channel Model of Flow. The evidence accumulated over the years corroborates the relationship between flow, organisational resources and the skill-challenge balance, substantiating flow's crucial contribution to the development of organizational and human capital (Delle Fave et al., 2011).

The above discussion introduces the concept of flow and its team level counterpart - team flow. Team flow has been regarded as a suitable indicator for project team effectiveness as, similar to individual flow, this shared property focuses the team's attention to embark on challenges, which lead to continuous learning and development that in turn result in opportunities for innovation and novel solutions, which are two of the most important features that characterise project teams. To encourage the emergence of the team flow experience in a project team, the literature has identified three main antecedents, the balance between skill and challenge, a clear collective goal and immediate feedback.

Moreover, the literature also suggests that for a team to have a good grounding, certain team level resources need to be in place. The following discussion moves on to two potential team resources: that of team efficacy, an emergent collective level cognitive phenomenon and the collaborative zone of proximal development, an optimal interactive configuration of a project team.

2.3 Team efficacy

2.3.1 Self-efficacy

Self-efficacy is a concept explaining the process of behaviour acquisition and regulation, or put simply and broadly, learning. Defined by Bandura (1977, 1986), self-efficacy is a person's task-specific self-estimation of his/her ability to successfully accomplish a certain task. The efficacy expectation is a cognitive mechanism which motivates the initiation and persistence of the desired behaviour. Unlike an outcome expectation, which is a person's conviction that certain behaviours will result in a given outcome, the efficacy expectation is someone's confidence in successfully carrying out the required action to produce the intended outcome. An outcome expectation might not be enough to motivate someone to act on the desired behaviour because if someone has doubts in his/her ability to successfully execute the required course of action, he/she might not engage in the activity at all. In other words, the intensity of someone's efficacy beliefs are influential in determining whether they would attempt and stick to a task and eventually succeed. Bandura rationalised this connection between one's cognitive evaluation of self-efficacy beliefs and behavioural change, explaining that "*...Theoretical formulations emphasizing peripheral mechanisms began to give way to cognitively oriented theories that explained behaviour in terms of central processing of direct, vicarious, and symbolic sources of information...it has now been amply documented that cognitive processes play a prominent role in the acquisition and retention of new behavior patterns. Transitory experiences leave lasting effects by being coded and retained in symbols for memory representation.*" (Bandura, 1977, p192).

Based on the theoretical framework of Social Cognitive Theory (SCT), which postulates that people learn and develop through the observation of others and their social experiences, Bandura posits that the self-efficacy beliefs are shaped and developed by four sources, these are: "*performance accomplishments, vicarious experience, verbal persuasion and, physiological states*" (Bandura, 1977, p195). Specifically, *performance accomplishments* or *mastery experience* is influential in the development of efficacy expectations in that repeated personal experiences of success cultivate strong task-specific confidence. As explained by Erik Erikson in his book Identity and the Life Cycle, *"Children cannot be fooled by empty praise and condescending encouragement. They may have to accept artificial bolstering of their self-esteem in lieu of something better, but what I call their accruing ego identity gains real strength only from wholehearted and consistent recognition of real accomplishment, that is, achievement that has meaning in their culture."* (Erikson, 1994. p95.) Erikson's observation applies not only to children. Indeed, such strong efficacy beliefs can navigate an individual through occasional setbacks and the experience of overcoming difficulties, in turn, strengthens efficacy expectations. Moreover, mastery experience promoted efficacy beliefs have a tendency to generalise to similar activities and occasionally even to other situations (Bandura, Blanchard, & Ritter, 1969).

Self-efficacy beliefs can also improve by observing an identifiable model accomplish a task, the process of *social modelling,* or *vicarious experience.* The cognitive process of social modelling results in an increase or decrease in one's own self-efficacy after observing a model succeeding or failing in doing something. It is worth noting that, this identification or perceived commonalities with the model, affective or cognitive, facilitates the observer to follow the example of a model in accomplishing similar tasks. Bandura (1977) explains that human behaviour improves through modelling because the process of response acquisition is a very important aspect of learning. The behaviour initially learned through observation would be further refined through a self-corrective adjustment informed by performance feedback.

Another way to boost self-efficacy is through *verbal persuasion.* More often than not, a word of encouragement or suggestion from another person can

lead to the belief that one is capable of coping with a difficult situation. However, without evidence of success, the influential power of verbal persuasion is limited and proves to be weak especially in the face of the repeated experience of failure.

The fourth factor contributing to the rise and fall of one's efficacy beliefs is the *state of physiological arousal*. The competency of someone in the face of a challenging task could be influenced by their psychosocial status. For example, if someone experienced extreme anxiety when speaking in front of an audience, it might be because he/she is not very confident in his ability of public speaking. Conversely, it is also common that people could be further debilitated when they experience aversive or stressful or situations. The cognitive evaluation process and physiological arousal share a reciprocal feedback loop. All four factors discussed above are anchored in social cognitive processing mechanisms which serve as informational and motivational sources of self-efficacy beliefs.

2.3.2 Team efficacy

Self-efficacy has been studied and applied in a variety of areas such as health behaviour research (Luszczynska, & Schwarzer, 2005), computing abilities (Brauner, Leonhardt, Ziefle, & Schroeder , 2010), and general educational settings (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996) etc., however, the focus of the research has mainly been placed on the individual level. The conceptual and practical aspects of efficacy at a collective level, e.g. team or group, are less well investigated. The discussion above has focused on the cognitive mechanism regarding the promotion and application of efficacy expectations of an individual. To understand efficacy on a higher level however, the nature of emergence plays an important role.

In its inception, the definition of team efficacy or collective efficacy (the term team efficacy and collective efficacy is used interchangablely hereafter) had been ambiguous about whether these collective competency beliefs refer to the sum of individual members' self-efficacy beliefs or a shared perception (Zaccaro, Blair, Peterson, & Zazzani, 1995). Many researchers have attempted to define collective efficacy. For example, Prussia and Kinicki (1996, p 188) described

collective efficacy as "*perceptions regarding a team's capability to perform in a particular situation*". However, definitions such as the latter fail to delineate whether collective efficacy refers to a shared perception of the collective unit or as individual perceptions. Bandura (1997) proposes that collective efficacy is a shared perception and defines it as "*a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments*" (p477). Bandura further speculates that collective efficacy beliefs play a central role in a group's operative capabilities.

Team efficacy is deeply rooted in self-efficacy (Bandura, 1982). Unlike cumulative team level properties such as team size, team average age, and team longevity etc. that exist independently of individual perceptions, shared team efficacy beliefs reside within individual team members and are derived from their personal perceptions. The complex phenomenon of team efficacy is the combined product of the group's interactive pattern (Tasa, Taggar & Seijts, 2007), and team members' perceptions of each other's competence, motivation and performance. Therefore, similar to team flow, collective efficacy is seen as the most dynamic type of meso-level construct. Klein & Kozlowski (2000) explains that the 'shared' perceptions determine the appropriate level of analysis of a collective construct. In line with the argument of Social Cognitive Theory, Gully, Incalcaterra, Joshi, & Beaubien (2002, p 821) explained that "*Shared perceptions imply that the social fabric of the team is tightly interwoven and that the perception of any single individual is likely to be influenced heavily by the behaviors, attitudes, and motivations of other members. In such cases, shared perceptions effectively capture the internal dynamics of the team.*" Therefore, as the shared perception of the team's task-specific competency emerges from such an interdependent collaboration, it should not be simplified as the sum of individual member's self-efficacy beliefs (Chan, 1998). The unit of agency is the team. The cognitive query of "can we do this task" is different from the cognition "can I do this task?" (Mischel & Northcraft, 1997). This distinction is well reflected in empirical research. For example, in Arthur, Bell & Edwards (2007), the researchers tested and compared the criterion validity of both the referent-shift operation (changing the referent from "I" to "we") and the additive approach of the individual referent operation. The result shows that the referent-shift operation of team efficacy is far

more reliable in predicting team performance than that of the additive operation. In other words, self-efficacy and team efficacy are two distinct constructs, both theoretically and operationally speaking.

Team efficacy also suffers from conceptual confusion as with other team-level constructs. Team efficacy and team potency are two types of team capability beliefs that have been studied and, sometimes, used interchangeability in the literature (Jung & Sosik, 2003). However, in terms of their respective focus or specificity, these two constructs are theoretically distinct (Collins & Parker, 2010; Gully et al., 2002 Mathieu et al., 2008). Team potency refers to "the collective belief in a team that it can be effective" (Guzzo et al., 1993, p.87). Compared to team efficacy beliefs, team potency is a more general and global perception of a collective belief in a team's capability. Team-efficacy, on the other hand, is domain-specific. It refers to the shared belief of a team's capability in dealing with a specific task. For an even more fine-grained look into the different types of team capability beliefs, Collins and Parker (2010) conducted a study examining three similar constructs, these are team potency, and two types of team efficacy: team process efficacy and team outcome efficacy. Team outcome efficacy reflects a team's collective confidence in their ability to accomplish (in terms of the quantity and/or quality of) a specific task while team process efficacy refers to the collective belief of a team in its ability to work together, pool their resources, coordinate actions and manage interpersonal relationships (Mischel & Northcraft, 1997). In their longitudinal study of MBA study teams (total N=130), Collins and Parker (2010) reported that all three constructs show factorial distinctions, indicating that these three similar constructs actually reflect distinct phenomena. In terms of their predictive validity, team outcome efficacy was found to be the strongest predictor of objective performance, while team process efficacy was stronger in predicting extra-role behaviour, in this case, citizenship behaviour. Team potency was found to be a significant but weaker predictor of both objective performance and citizenship behaviour. In their meta-analysis, Stajkovic et al. (2009) found that the relationship between potency and performance was fully mediated by collective efficacy, meaning that team efficacy fully explained the predictive ability of team potency on team performance. Based on the discrepancy in the predictive strengths of these three similar constructs and considering the team flow's close

relationship with team performance (Sawyer, 2007), the present research focuses on team outcome efficacy as a variable of interest.

2.3.3 The reciprocal relationship between team efficacy and team effectiveness

Recalling the discussion on team flow, Salanova, et al., (2014) found supporting evidence for a reciprocal model between team flow and team efficacy, proposing the Extended Channel Model of Flow with team efficacy as a resource for team flow. The following discussion expands on this idea and explains the reciprocal mechanism between team effectiveness and team efficacy. The research on the effects of self-efficacy is a well-established area, and as it is a task-specific competency belief, reviews on efficacy beliefs are conducted in specific fields, for example, the achievement in writing (Pajares, 2003), parent and child adjustment (Jones & Prinz, 2005), schools (Usher & Pajares, 2008), sports performance (Moritz, Feltz, Fahrbach & Mack, 2000) and counselling (Larson & Daniels, 1998), to list but a few. In the occupational setting, however, the function of self-efficacy is mainly associated with motivation and task performance. In the same vein, team efficacy has been recognised in the team effectiveness literature as a significant and assessable construct. Although neither the unit of the agency nor the intended outcome is the same for personal efficacy and collective efficacy, they share the similar the four sources (i.e. *performance accomplishments, vicarious experience, verbal persuasion and, physiological states*" (Bandura, 1977, p195).) and the underlining psychological process of regulation. In other words, personal efficacy and team efficacy share a cross-level isomorphism conceptually and functionally. Isomorphism, as defined in Bliese, Chan, & Ployhart, (2007; p533.) is the *"similarity or one-to-one correspondence between two or more elements*". Similarly, cross-level isomorphism indicates a similarity in the meanings and properties of a higher-level construct with its lower-level counterpart. Based on the theoretical underpinnings of cross-level isomorphism, it is assumed that collective efficacy shares similar sources, features and functions with the psychological processes of personal efficacy. Therefore, it is reasonable to posit that *"people's beliefs in their team's efficacy influence the type of future they seek to achieve, how they manage their resources, the plans and strategies they construct, how much effort they put into their group endeavor, their staying power when collective*

efforts fail to produce quick results or encounter forcible opposition, and their vulnerability to discouragement" (Bandura, 1997; p. 478). To put it another way, Bandura's statement implies that similar to personal efficacy, collective efficacy promotes team effectiveness through its impact on collective goal setting, team behavioural regulation, effort investment, resilience and persistence, for which some supporting empirical evidence has been found and documented in the literature (Bandura, 1986; Earley, 1999; Feltz & Lirgg, 1998; Gibson, Randel & Earley, 2000; Gully, Incalcaterra, Joshi, & Beaubein, 2002; Prussia & Kinicki, 1996; Salanova, Rodriguez-Sanchez, & Schaufeli, 2014; Whitney, 1994).

Similarly, team effectiveness promotes team efficacy as well. As the IMOI model posits, a cognitive process such as team efficacy and its outcomes share a reciprocal feedback relationship that is mutually reinforcing. For example, if members share collective disbelief in their collective competence, a downward spiral self-defeating dynamic might emerge to cultivate a lack of motivation and drive in each of the individual members, which will make members withdraw. In contrast, when members of a team share a strong positive perception of collective efficacy, a high level of performance might result through an upward self-fulfilling spiral. In addition, this dynamic of shared positive team efficacy may breed a vitality or collective resilience that draws the members back and closer to an effective team. Grounded in Social Cognitive Theory, this description postulates how shared team efficacy, positive or negative, emerges as a product of the social environment that the individual members mutually create and how and why it could lift or suppress motivation, effort, and persistence in the team members (Lindsley, Brass, & Thomas, 1995). Lindsley and colleagues (1995) coined this cyclic interdependence between team efficacy and team performance the "*deviation-amplifying loop*", which indicates that psychological phenomena build on each other to form an upward or downward spiral of causal relationships. In other words, change in one variable leads to a change in the other and vice versa.

2.2.3.1 Team flow and the four sources of team efficacy

Looking at the four contributing factors to efficacy beliefs, this line of reasoning is also sensible. Although the unit of agency discussed here is the team,

not the individual, considering the heuristics of cross-level isomorphism, repeated collective experiences of success and peak performance such as team flow, also breeds a sense of task-specific confidence in the team members, whose perceptions of the team's competency gives rise to the emergence of team efficacy through interactions and cooperation. In other words, team flow as a type of mastery experience serves as a direct source of collective efficacy. In addition to mastery experience, the tightly interwoven social fabric within a team also offers the opportunity for members to learn and model each other. Witnessing the success of a team member boosts an individual's confidence in carrying out similar tasks and/or instils the individual with the faith in the team as a whole to face challenges. Perceived commonalities with the model team member facilitate learning through the process of feedback acquisition. Although project team members often are assigned different functions and responsibilities, the feedback passed on could contribute to the experience of overcoming project-related obstacles in general. Social modelling could also imply the learning of a team as a whole by observing another team's successes or failures. Granted the team itself cannot really "see", however, the individual members' observations can augment the collective observation of the teams through the social fabric or interactions between members. Moreover, the physiological arousal induced by team flow such as enjoyment, intrinsic motivation and intense concentration, serves as a good base for promoting team efficacy. As a collective sensation spreading across members, flow excites a team and encourages the feeling of confidence. Naturally, within the social context of a team, members would communicate and verbalise experiences of peak performance with one another as a means of verbal persuasion.

2.2.3.2 Team efficacy and team flow antecedents

A collective belief of team efficacy motivates team members to make positive evaluations in their ability to face challenges. Instead of seeing challenges as something formidable and make them want to procrastinate or give up, efficacy beliefs encourage team members to make an effort and seek out help and resources from within the team and externally to reach a solution. In other words, in the face of a challenge, a team that believes in its ability to find a way to tackle

difficulties would be able to perceive a balance between their skills and resources available and the challenges facing them. In the same vein, it is also sensible to propose that strong efficacy beliefs motivate teams to engage in activities such as task planning and structuring to clarify their goals and encourages members to seek and give feedback to one another based on the bonding and trust derived from their perceived team efficacy (DeRue, Hollenbeck, Ilgen, & Feltz, 2010). Nevertheless, evidence from the literature suggests that team efficacy beliefs have a non-linear relationship with performance. In their empirical study, Rapp Bachrach, Rapp and Mullins (2014) recruited 153 sales teams and finds that efficacy beliefs have an inverted U-shaped relationship with two performance indicators: team effort and objective team sales. This curvilinear relationship suggests that performance tends to get worse when a team is too low or too high on team efficacy. Low team efficacy demotivates a team and very high efficacy belief also discourages a team from making an effort as a result of being too complacent. Marks (1999) finds that student teams high on efficacy perform worse in coordination processes than less efficacious ones. Rapp et al. (2014) suggests that the beneficial consequences of efficacy on performance might work only within a threshold level. Nevertheless, it is worth noting that these studies have examined the impact of efficacy on contextualised performance indicators, which is not the same as an emergent collective state of team flow and its antecedents. As objective performance indicators are often affected by multiple factors, therefore it is reasonable to posit that there is still a linear positive relationship between team efficacy and team flow antecedents.

2.4 CZPD – the social breeding ground as team resources for flow

As is discussed earlier, Sawyer (2007, 2014) expects that a team experiencing team flow is performing at its peak, which keeps a team in a state whereby members are fully engaged in their collective activity, collaborating synergistically and intuitively for a common goal. If team flow could be seen as one form of team effectiveness the following question arises: How would one go about identifying and building the optimal team wherein team flow precursors can be cultivated, and team flow could emerge? Armstrong (2005, 2008) and Gaggioli

et al. (2015) posit that the establishment of a collaborative zone of proximal development (CZPD) could serve as such a collective breeding ground which can be considered as another resource for team flow in addition to team efficacy.

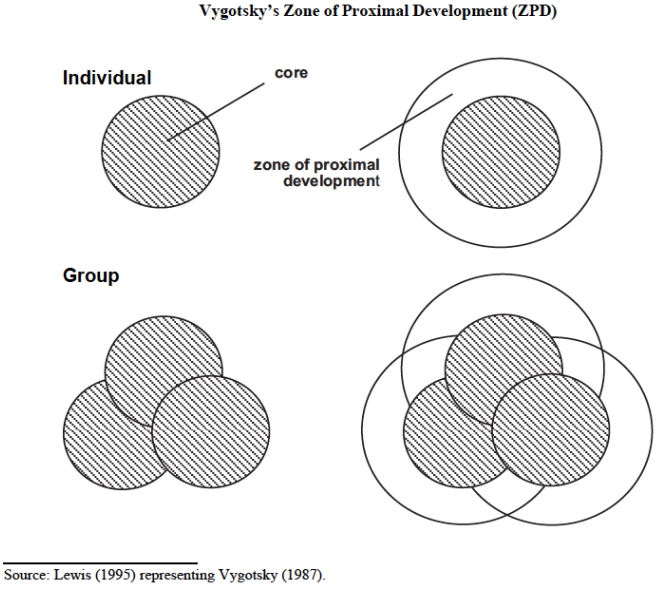


Figure 2-1: Vygotsky's zone of proximal development (ZPD) adopted from Lewis (1995)

2.4.1 The zone of proximal development (ZPD)

The concept of "the zone of proximal development" (ZPD) was first developed by Lev Vygotsky in 1978 (Wertsch, 1984). This Soviet psychologist, who interpreted human learning from a sociocultural perspective, proposed that cognitive development is mainly rooted in social interaction. The concept of ZPD refers to the intellectual area of "*about to be able*"(Gaggioli, Riva, Milani, & Mazzoni, 2012), where a learner's advancement of knowledge or the development of skills is actualised through the collaboration with a more experienced individual (Vygotsky, 1978). As shown in figure 2-1, depicted in Lewis (1995), the shaded sphere represents the core of a person's ability, which is the level of performance attainable without assistance. The band surrounding the core represents Vygotsky's "zone of proximal development" (ZPD), within which, by collaborating with more knowledgeable others, an individual "*can participate in performance at a higher level of complexity than that of which she/he can manage alone*" (Hansen, Dirckinck-Holmfeld, Lewis, & Rugelj., 1999, p.185). Therefore, the focal activity in the zone is not the transfer of skills to the individual but the collaboration between the individual and more knowledgeable others. As Hansen et al. (1999;

p.185) puts it: "*the development of cognitive structure happens when the individual internalizes a complexity that was formerly distributed over the system that she/he operates in*".

2.4.2 The collaborative zone of proximal development (CZPD) - reaching for a new balance

In Goos, Galbrith and Renshaw (2002), this concept of ZPD was extrapolated to the team level. They proposed that the concept of ZPD could potentially provide a rationale for the phenomenon of peer group learning process where the completed product is derived from each member's incomplete expertise perfected by the rest of the group's coordination and contribution. As illustrated in Figure2-1, the potential for a team to perform at a higher complexity resides in the areas where one member's ZPD overlaps with another member's core. This claim reflects Vygotsky's notion of equal status partnership in ZPD. Vygotsky observed that a group of children playing together are capable of acting at a level of development beyond any child's individual level of performance (Minick, 1987). This group or team level phenomenon is different from ZPD because there is no teacher or more experienced peer in the group to provide instruction. Goos et al. (2002) thus termed this peer-group learning phenomenon as the collaborative zone of proximal development (CZPD) to provide a distinction between an expert-novice social interaction (ZPD) and an equal status interaction (CZPD).

Self-organising phenomena are often classified as a learning system by complexity scientists who describe peer-learning as: "*ongoing, recursively elaborative adaptations through which systems maintain their coherences within their dynamic circumstances.*" (Davis & Simmt, 2003, p138). Small working teams such as project teams characterised with progressive elaboration are self-organising complex systems in nature. However, not all project teams can be defined as peer-collaborating and peer-learning, and the collaborative problem-solving process is the dynamics of co-construction wherein conflict often precedes consensus. If the conflict is destructive, power struggles pervade the system and peer-learning may fail to actualise, the self-organising system thus stops evolving and dies. Therefore, adaptivity and emergence are identified in Davis and Simmt (2003) as two essential

qualities for the development of complex systems, which is consistent with Darwinian philosophy wherein one's capability to adapt in structure and behaviour to internal and external 'shocks' over time enables one to survive and achieve a higher level of complexity. In other words, the peer collaboration and peer learning phenomena of CZPD are optimal collaborating structures of a self-organising entity that emerges over time through constant adaptation and co-construction, which, in turn, leads to team effectiveness. The following section describes five necessary conditions that characterise an effective self-organising complex learning system proposed in Davis and Simmt (2003).

2.4.3 The structural elements of CZPD

CZPD is inherently a collective level construct. Adapting other researchers' views (Bloom, 2000; Casit, 1994; Johnson, 2001; Kelly, 1995; Lewin & Regine, 2000), Davis and Simmt (2003) propose five conditions that are characteristic of a successful self-organising learning system like CZPD: (a) internal diversity; (b) redundancy; (c) decentralised control; (d) neighbour interactions (e) organised randomness. Internal diversity indicates the varieties of expertise and experience that comprise a team's range of achievable competencies. A team's internal diversity manifests mainly in two ways: in addition to offering suggestions and ideas, members also voluntarily take on different roles based on personal interests or expertise. For example, as observed in Davis and Simmt (2003), different members of a group take up different roles such as testing suggestions, communicating findings to members, etc. In Armstrong's (2008), some students would voluntarily record the content of their groups' discussions while others read out the instructions again to the whole team. As illustrated in figure 1, the benefit of internal diversity comes from the areas where one member's ZPD overlaps with another member's core. A project team can make use of this asymmetry of each other's expertise to enable product uniqueness. In other words, the extent of a team's internal diversity is the extent of a team's intelligence, its range of possibilities rooted in the variation and mutability of its components. Like the unexpressed DNA of a living thing or a specialised function of different brain regions, the internal diversity of a team is the source of possible responses to emergencies and shocks or simply in a project team's case, the source of improved

performance and product uniqueness. However, Davis and Simmt (2003) emphasise that all social groups are self-organising entities with complexity, codes of conduct, and social hierarchies that are already emerged. Therefore, for a project team whose aim is to generate unique products, roles need to be assumed and flexible because rigid top-down imposed roles hinder peer learning and the expression of the range of specialised expertise and interests of its team members.

Redundancy, on the other hand, refers to the similarities, or common ground, i.e. shared goals, resources, knowledge, terminologies and skills etc. among team members. The overlapping cores of group members in Figure 1 can be interpreted as the group's common ground or redundancy which constitutes "*a shared reference area or (recursive base) for exchanging information*" (Hansen et al. 1999, p.186). This area enables the development of shared meaning and understanding among members. These similarities in a team function in two ways: one is that they serve as the basis for internal coherence which enables an effective moment-to-moment interaction between the members which transforms the "*me's to a collective of us*" (Davis, & Smmit, 2003), facilitating the emergence of a coherent collective unity. The other function of shared similarities is that redundancies can compensate for failures of a team member and the loss and introduction of new members. Like the recovery process from brain injury, shared redundancies in a team enable the team to cope with stress, injuries and the impairment of its parts. It is thus conceivable that diversity is outward-oriented and serves as a facilitator for peer learning and innovation whilst redundancy is inward-oriented, and helps guide and coordinate members' interactions (Davis, & Simmt, 2003). Diversity is the reservoir for innovation and creativity (chaos disarray) and redundancy is the basis for unit stability (order).

Decentralised control and neighbour interaction refer to the frequency, density and structure of communication and interaction in a high functioning self-organising team. From a traditional cause-and-effect perspective, control refers to a coordinating agent, an overseer, a director, and a deliberate strategic action such as planning (Davis, & Simmt, 2003). For example, in a typical centralised unit such as a Squad in the army where soldiers are expected to follow the orders of their staff sergeant; or a typical classroom where the teacher represents the authority.

From a complex emergence point of view, however, the control of a collective unit is its shared properties such as the social-cultural collective, the intelligent behaviours etc. In other words, the shared project or purpose is the central theme around which the collective emerges and sustains itself. There are two extreme cases in which imposed control hinders emergence. When a collective is exclusively led by an expert who prescribes the correctness of a project, the collective becomes homogenous and its diversity is disregarded. On the other hand, when a collective focuses its attention on only emphasising the distinctions between the members, then redundancy is relinquished and there is nothing left but a collection of completely unrelated parts. As Kelly (1995) states, for a phenomenon to emerge, authority needs to be abandoned to a certain degree. The locus of control in a collective unit sits at either of these two extremes, not in the individual members or an expert or an authority, but in the shared ideas. Therefore, power and authority in a project team is the collective crafting of their discourses, shared actions and formatting etc. through which, the centre of control emerges through its unique products, shared codes of conduct, shared acceptance of correctness etc.

Neighbour interaction does not refer to the interactivity between two members in a community. Here, neighbours are considered to be the units of knowledge within a complex system (Davis & Smmit, 2003). As Varela (1999, p7) discusses: "*the proper units of knowledge are primarily concrete, embodied, incorporated, lived*". Within a self-organising system, the units of knowledge exist in the forms of suggestions, concepts, queries, metaphors or even hunches which constitute the entity's internal diversity. For a complex system such as a project team to generate the outcome it was commissioned to produce, these units of knowledge will have to be made to interact, collide and bump off each other. Put another way, a project team's product uniqueness is actually an activity, an elaboration process which focuses on the exhibition, interpretation, and integration of various ideas. Therefore, to avoid misunderstanding, I propose to change the notion of neighbour interaction to idea interaction. The quality of the output of such a process depends on the density of the interaction. In other words, a continuous, active exchange between the core and ZPD of team members

enhances the crowdedness of ideas distributed in a self-organising system from which product uniqueness is achieved.

Organised randomness is a team's structural condition that serves to balance internal diversity and redundancy when the team task requirement is characterised with a set of liberating constraints (Davis & Smmit, 2003). While prescription refers to severe constraints, the type of requirement that is strictly rule-based, time-constrained, outcome specified and redundancy -oriented, proscription, on the other hand, refers to open exploration with no limits and diversity-oriented (Davis & Smmit, 2003). However, being neither redundancy-oriented nor diversity-orientated, the liberating constrains enable the emergence of a complex system by finding the right balance between diversity and redundancy, allowing for rich possibilities and innovation to emerge whilst still achieving a predetermined goal. Accordingly, it is plausible to speculate that organised randomness is the key condition for a team to function in its collaborative zone of proximal development, an optimal form of complex emergence that enables an entity to be "smart" enough to manoeuvre the dynamic balance between diversity and redundancy in response to external and internal contingencies. Directing the centre of attention of the team to the tasks, organised randomness emerges as a result of liberating constraints that accommodate a variety of interpretations and possibilities within the reasonable boundaries that define the uniqueness of a product. Nevertheless, for a project team, the parameters of activities are an ongoing negotiation. Through the process of elaboration, the appropriate level of liberating constraints emerges.

2.4.4 CZPD, team developmental processes and the affective mechanisms of team flow and team efficacy

The above discussion of CZPD shows that five conditions of an optimal self-organising unit are closely related to one another and facilitate the emergence of team effectiveness by enhancing the speed and quality of team developmental processes. By balancing liberating constraints (organised randomness), a project team is capable of finding the appropriate configuration of redundancy and diversity contingent on the dynamics from within and outside of the team. For

example, as discussed in the team compilation model, when a team is newly formed, it is still a collection of individuals trying to figure out their social fit and what the team is commissioned to produce. As a result, a team could be riddled with conflicts as a result of power struggles and confusion over the team task and performance rules. However, teams in CZPD would be able to rely more on its redundancy to improve communication and coherence by building on their shared understanding of background knowledge and similarities in culture and climate etc. At the first two stages in the team compilation model, a project team is regarded as still operating at the individual level, is inward-oriented and in the process of building up their interpersonal knowledge, task knowledge and skills, and shared norms and goals. In the third stage, a team starts to move away from an over-concentration on redundancy, begins to explore the beneficial consequences of their diversities. After identifying the key roles, members start to negotiate their functional relationships and appropriate codes of conduct to regulate task-related interactions. Although this stage is primarily dyadic, members are capable of recognising and taking advantage of the asymmetry of each other's expertise and backgrounds, learning and developing to perform with equal status interaction. This is where a team starts to move towards an outward orientation, focusing on dealing with external challenges. In the final sage, a team has successfully established an interdependent self-organising complex system that is capable of continuous adaptation and the generation of product uniqueness through progressive elaboration, a process characterised with an active idea interaction governed by task-centred decentralised control. Kozlowski and Bell (2013) emphasises that team compilation can be an iterative cyclical developmental continuum, a successful transition from fragmented individual operations to the emergence of a team level self-organising system through the facilitation of CZPD, the social breeding ground for team effectiveness.

Alongside the emergence of CZPD, other types of cognitive and affective psychological properties of teams also emerge. Two such properties which are of interest to this research are team flow and team efficacy. As shared team properties, the emergence of team flow and team efficacy are indicated by a lower within-team variance compared to a between-team variance, or how much the members share each other's perception of team flow and team efficacy.

Homogeneity of within team perceptions depends on the team's capability of keeping a relatively stable team dynamics in the face of internal and external "shocks", such as member conflicts and member turnover, or unexpected challenges or stress imposed by an external authority. CZPD facilitates and maintains a team's homogeneity of perceptions by moving it along the team compilation process quickly while maintaining a coherent and effective team, which serves as an ideal social space for the emergence of shared properties such as team flow and team efficacy.

Specifically, CZPD promotes the emergence of team flow by nurturing its three antecedents: balance of skill and challenge, clarity of goals and immediate feedback. As an equal status, peer-learning team, in addition to creating a stable, effective and resilient system, CZPD also enables a team to stay at the edge of being "about to be able" (Gaggioli et al., 2012) when facing new challenges. Drawing on the team's reservoir of diversity and redundancy, a team in CZPD can quickly acquire the right skills and find new solutions challenges. Keeping the centre of control fixed on the task, a team in CZPD makes sure that it is clear in its goals and keeps the team updated on any adjustments of their goals through progressive elaboration. A good density of idea interaction drives not only the possibility of product uniqueness but also rapid and constructive feedback to each other's ideas, suggestions and performance. Reciprocally, the emergence of team flow also reinforces CZPD. As the psychic compass, Flow directs psychological selection to repeat the activities that reinforce the occurrence of flow. In progressive elaboration, project teams experience team flow as a peak performance experience through ongoing problem-exploration and problem-solving. In this cycle, teams develop the abilities to find their appropriate organised randomness in which team members skilfully balance their use of the team's diversity and redundancy. Because team flow also gives rise to intrinsic motivation for continuous improvement and learning, members are driven to give suggestions and opinions, exchange and integrate ideas to enhance the quality of their product. Absorption ensures that members are co-ordinated around the task goal, and not busy figuring out their place in the team's social hierarchy.

CZPD and team efficacy also share a reciprocal relationship. A team in CZPD is an equal status peer learning system which encourages constant exchange between the core of one member's skills and the ZPD of another. Members learn, grow, teach and give at the same time. The density of ongoing micro-learning experiences provides repeated mastery experience and opportunities for modelling among members which ultimately translate into a sense of joint progression with the task at the centre of control. Team level efficacy is therefore reinforced by CZPD. Similarly, a team with members sharing a collective sense of efficacy trust each other's ability and accountability. They respect each other's expertise and use one another's feedback constructively. Idea interaction thus grows in density as members are willing to chip in ideas, discuss and integrate their insights. Trust in the collective ability motivates members to demonstrate and identify each other's skills so as to prevent the team from over-relying on one member for guidance and direction and encourages an even distribution of authority over the development of the project. A confident project team with a collective perception of "Yes, we can." is, therefore, a team capable of balancing its members' unique expertise and shared knowledge.

2.5 Proposing the psychological and behavioural resources of team flow model (PBrTF)

The literature reviewed in Chapter I provides a survey of the contemporary theoretical frameworks essential to the understanding of team level phenomena. Through the lenses of the IMOI framework (Mathieu et al 2008), team compilation model (Kozlowski et al., 1999) and Multilevel Theory (Kozlowski, 2015), the chapter serves as the foundation for the better understanding of team level psychological concepts, their nature and dynamics from the vantage point of the critical conceptual foci of team research put forward by Kowzlowski and Bell (2013). The above discussion in Chapter II turns to three specific team level phenomena, namely team flow, team efficacy and CZPD. The review illustrates that CZPD is a social breeding ground for team effectiveness that serves as a driving force for team compilation, and therefore enhance the emergence of team flow and team efficacy. Its relationship with team flow and

team efficacy is considered causally reciprocal and mutually reinforcing. However, to fully appreciate this three-way relationship and its implications, one must integrate the arguments using the Social Cognitive Theory (SCT; Bandura, 1986).

SCT is essentially a social learning theory which proposes that learning or knowledge acquisition can be actualised through the observation of a model performing an activity and the consequences of such an action in the context of social interactions (Bandura, 1986). SCT emphasises that human psychological functioning is an interactive process between three influential determinants, namely the personal or psychological influence, the behavioural influence and the environmental influence (Bandura, 1986, 2006; see Figure 2-2 for an illustration of this triadic reciprocal causation framework) to highlight the bidirectional influences between the three determinants.

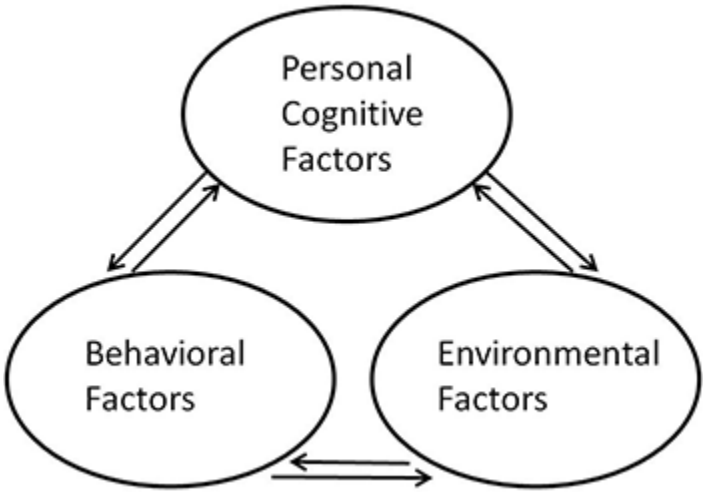


Figure 2- 2. Personal, environmental and behavioural influences

Specifically, the personal or psychological aspect of SCT encapsulates a wide range of systems including cognitions and emotions such as thoughts, beliefs, self-perceptions, affects and expectations. As discussed in section 2.3, efficacy beliefs are considered a cognitive mechanism that have a big influence on human agency such as self-regulation, self-development and self-reflection (Bandura, 1986). Human agency can operate in a collective mode, i.e. collective agency, in that a social collective such as a project team can collaborate to obtain a common goal (Bandura, 2000; Luszczynska & Schwarzer, 2005). Also, collective efficacy can have an impact on people's perceptions of their working environment, for

example, the workload they are subjected to. In the context of this thesis, team efficacy is considered to influence the team's behavioural aspect of CZPD in that collective confidence in the team's competency encourages members to interact with one another, discuss and exchange ideas. Because of the latter, a sense of trust develops, wherein members can operate without anyone trying to enforce control over the team, but instead allowing a distributed leadership style to emerge. Also because of this team efficacy, members are willing to learn from each other and rely on each other's expertise to improve their collective performance. A team without faith in their task-related competency would not be motivated to explore the richness of the members' diversified skill and knowledge reservouir, and neither would they be encouraged to build up the shared task-related knowledge base. Moreover, as discussed earlier in section 2.3, team efficacy encourages a positive evaluation of the team's competency, which allows members to believe that their team possesses a collective level of skills that matches the challenge of the task, thereby inducing the experience of team flow.

The behavioural aspect of SCT is regarded as a response to performance, action and skill development. People's evaluation and interpretation of the outcome of this behaviour influences the psychological and environmental aspects (Bandura, 1989). Within the context of this thesis, CZPD is considered as a behavioural aspect, which can be regarded as the team's collaborative structure that allows for the emergence of an adaptive self-organising entity. For a team to exercise CZPD, it needs to be able to balance its redundancy and diversity based on nature of the task. Such effective employment of collective resources is achieved through a process of action-reflection and regulation. Members learn to understand their team's reservoir of resources, the extent of their capability and how to utilise it by observing the consequences of the team's action. (CZPD-efficacy) The establishment of such a collective breeding ground of team effectiveness influences the team's psychological state, i.e. its team efficacy. One the other hand, as a source of mastery experience, CZPD strengthens and reinforces the team's awareness of its collective level capability and therefore promotes the collective level of efficacy beliefs. On the other hand, when a team is operating in CZPD, it is an entity smart enough to effectively balance the skill and knowledge diversity and redundancy in accordance with the dynamics of the

task requirement. Such efficient collaboration contributes to the perception of skill-challenge balance and the emergence of team flow.

The environmental aspect of SCT refers to the social, physical or the psychosocial work environment that is external to the person or the collective (Theorell, 2007). The psychosocial work environment is a concept covering both the work and working conditions, which include the perceived work characteristics such as demand and control (Stansfeld & Candy, 2006). According to Demerouti, Bakker, Nachreiner and Schaufeli (2001), the psychosocial work environment is a key influencer on the performance, well-being and health of employees. In the context of this thesis, the perceived balance between skill and challenge and the team flow experience are considered as environmental factors that influence both the psychological aspects of team efficacy and behavioural elements of CZPD. As discussed in section 2.2, Sawyer defines team flow as "*a collective state that occurs when a group is performing at the peak of its abilities*" (2014; p. 167). This definition encapsulates the conceptualisation of Team Flow in the workplace. Repeated exposure to such mastery experience shapes the team's perception of the work environment and improves collective efficacy beliefs. The work environment also shapes the development of CZPD. As theorised in section 2.4, for a team to operate with the organised randomness of CZPD, it is necessary for the project requirement to have a set of liberating constraints. Tasks requirements that are either extremely rigid or rule-bound or emphasise only limitless exploration would not encourage the emergence of organised randomness.

The above discussion illustrates how team efficacy, CZPD and team flow interact to influence one another within the conceptual framework of SCT. While SCT makes this causal relationship integrated and coherent, it does not specify the direction of these relationships. However, Fredrickson's (1998) Broaden and Build theory of positive emotions might shed light on this matter. The Broaden and Build theory of positive emotions postulates that positive emotions or cognition broaden the attention and thinking process momentarily, which opens up the gateway to a higher level connection and widens the range of ideas and perceptions. This broadened outlook encourages people to enhance their personal resources, which include cognitive, psychological, social and physical

resources (Fredrickson & Kurtz, 2011). Specifically, the enhancement of cognitive resources could lead to better concentration and focus; strong psychological resources mean the ability to hold on to a sense of mastery when facing challenges and a resilience to adversity; social resources include the love and support given and received; a good physical condition means well maintained bodily functions such as good sleep and robust immune system. In sum, Fredrickson's broaden-and-build theory postulates that frequent exposure to positive emotions kick-starts an upward spiral between positive affect and the personal resources which, over time, sustain human flourishing (Fredrickson & Kurtz, 2011). Accordingly, within this framework, team efficacy can be considered as a psychological resource that sustains mastery experience in the face of challenges; and CZPD can be seen as a social resource in which members cooperate and support one other. Therefore, as previously explained, the optimal experience of team flow as a psychic compass for improvement and learning is expected to act as an engine of positive emotion perpetuating an upward spiral effect, enhancing and maintaining the team resources of team efficacy and CZPD. In turn, as discussed in section 2.2.3, team efficacy and CZPD serve as resources for team flow, fuelling a positive feedback loop to team flow. Moreover, as discussed in section 2.4.4, the enhancement of psychological resources such as team efficacy brings about a positive evaluation of each member's ability, which promotes an effective social structure such as CZPD. Moreover, the experience of collaborating in an effective self-organising system acts as the source of mastery experience of team efficacy. Thus, within the Broaden-and-Build framework, the psychological and social resources form a mutually beneficial relationship as well.

The above discussion integrates the insight of SCT and the Broaden and Build theory to frame the relationship between team flow, team efficacy and CZPD. Building on Salanova and colleagues' (2014) Extended Channel Model of Flow, which posits that team efficacy serves as the psychological resources of team flow, this thesis incorporates CZPD as the missing piece of the behavioural resources of team flow. Based on this theorisation, this thesis proposes the psychological and behavioural resources of team flow model (PBrTF). As illustrated in Figure 2-3 team efficacy and CZPD serve as the psychological and behavioural resources of team flow and this relationship is mediated by team flow

antecedents. Team flow acts as the engine of positive emotions, which broadens and builds its resources of team efficacy and CZPD. The positive experience of CZPD and team efficacy also shares a mutually reinforcing relationship.

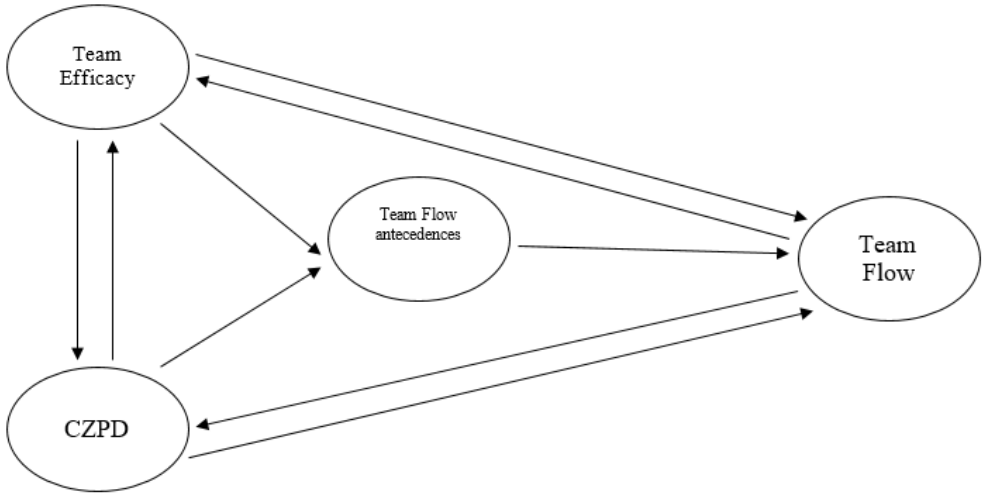


Figure 2- 3. The proposed Psychological and Behavioural resources model of Team Flow (PBrTF)

2.6 Research objectives and research questions

This chapter introduced three team-level emergent phenomena, namely team flow, team efficacy and CZPD. The literature has highlighted that all three constructs have meaningful implications for the improvement of team effectiveness. As emergent team level phenomena, these constructs are the most dynamic and responsive to interventions, which makes them ideal candidates for team effectiveness research and interventions. However, given the beneficial implications of these constructs to project teams, very little empirical research has attempted to explore the nature of, and relationships between them. Apart from Salanova et al. (2014), no study has attempted to integrate team flow and its associated resources into a theoretical framework to consolidate their theoretical connections.

Therefore, this thesis intends to contribute to the exciting body of knowledge on team effectiveness by developing and testing the psychological and behavioural resources model of team flow (PBrTF). In positioning the three elements of team flow, team efficacy and CZPD within the SCT framework, this research aims to enhance team effectiveness by exploring and testing the interplay

between the psychological, behavioural and environmental elements of team effectiveness in project teams. Additionally, considering the positive nature of these three concepts, this thesis also attempts to place the proposed PBrTF model under the lens of the Broaden and Build theory and identify the psychological and social resources of team flow. By incorporating a positive psychology lens into the traditional SCT model, the proposed PBrTF model aims to advance our understanding of team effectiveness and flourishing. Moreover, by refining and enhancing and operationalising the underdeveloped concept of CZPD, this thesis aims to complete the SCT framework of team flow by adding the behavioural element into the SCT triad.

To investigate this proposed model, this thesis sets out to achieve four overall objectives through their corresponding research questions and hypotheses listed below in four studies:

Study 1:

i. As CZPD is a relatively new construct, the first objective is to explore and further develop its conceptualisation and its relationship with team efficacy and team flow.

    1) Research question: How do the teams organise their interactions in terms of the five characteristics of CZPD, namely idea interaction, decentralised control, diversity, redundancy, and organised randomness?

    2) Research question: Does a team's CZPD have an association with the emergence of team efficacy and team flow?

ii. Based on a more concrete understanding, develop a questionnaire to operationalise CZPD. The process of an item-pool development is detailed in Chapter III.

Study 2:

iii. Pilot testing this new questionnaire of CZPD by examining its dimensional validity and measurement stability.

3) Research question: Do the items in the CZPD pilot questionnaire reflect a single dimensional latent structure, or multiple dimensions?

a. Hypothesis: Based on the preceeding discussions, it is hypothesised that CZPD reflects a single dimensional structure (H1).

4) Research question: Does the CZPD pilot questionnaire have a monotone hierarchical structure?

b. Hypothesis: the CZPD pilot questionnaire satisfies a monotone hierarchical model.

Study 3:

iv. Testing the dimensional stability of the four questionnaires of CZPD, team efficacy, team flow antecedents and team flow.

5) Research question: Is the team efficacy questionnaire stable in its monotonic hierarchical dimensionality from T1 to T2?

c. Hypothesis: the team efficacy questionnaire has the cross-lag monotonic hierarchical dimensionality from T1 to T2.

6) Research question: Is the CZPD questionnaire stable in its monotonic hierarchical dimensionality from T1 to T2?

   d. Hypothesis: the CZPD questionnaire has the cross-lag monotonic hierarchical dimensionality from T1 to T2.

7) Research question: Is the team flow antecedents questionnaire stable in its monotonic hierarchical dimensionality from T1 to T2?

   e. Hypothesis: the team flow antecedents questionnaire has the cross-lag monotonic hierarchical dimensionality from T1 to T2.

8) Research question: Is the team flow questionnaire stable in its monotonic hierarchical dimensionality from T1 to T2?

   f. Hypothesis: the team flow antecedents questionnaire has the cross-lag monotonic hierarchical dimensionality from T1 to T2.

Study 4:

v. Empirically testing the proposed PBrTF model using this new CZPD questionnaire and established team efficacy and team flow questionnaire.

9) Research question: Do team flow and team efficacy share a positive reciprocal relationship in that teams that possess a higher level of task-specific confidence

are more likely to experience team flow and vice versa?

g. It is hypothesised that there is a reciprocal causal relationship between team efficacy and team flow in that, team efficacy level at the beginning of a team's project positively predicts the perceived team flow at the end of a team project; and team flow level at the beginning of a team project positively predicts the perceived team efficacy at the end of a team project.

10) Research question: Does team efficacy promote the experience of team flow through its positive effect on team flow antecedents?

h. It is hypothesised that team efficacy at the beginning of the team project positively predicts the level of team flow antecedents at the end of the project; team flow antecedents at the beginning of the team project positively predicts the level of team flow at the end of the project;

team flow antecedents mediates the relationship between team efficacy and team flow.

11) Research question: Do team flow and CZPD share a positive reciprocal relationship in that teams with a higher level of CZPD would be more likely to experience team flow and vice versa?

i. It is hypothesised that there is a reciprocal causal relationship between CZPD and team flow in that, (H3a) CZPD at the beginning of a team project positively predicts the perceived team flow at the

end of a team project; (H3b) and team flow level at the beginning of a team project positively predicts the CZPD at the end of a team project.

12) Research question: Does CZPD promote the experience of team flow through its positive effect on team flow antecedents?

j. It is hypothesised that CZPD at the beginning of the team project positively predicts the level of team flow antecedents at the end of the project; team flow antecedents mediates the relationship between CZPD and team flow.

13) Research question: Do CZPD and team efficacy share a positive reciprocal relationship in that teams possess a higher level of task-specific confidence would have a higher level of CZPD and vice versa?

k. It is hypothesised that there is a reciprocal causal relationship between CZPD and team efficacy in that, team efficacy level at the beginning of a team project positively predicts CZPD at the end of a team project; and CZPD at the beginning of a team project positively predicts the perceived team efficacy at the end of a team project.

2.7 Chapter summary

Based on the work team related theoretical frameworks reviewed in Chapter I, this chapter reviewed the concept of team flow, team efficacy, and developed the construct of CZPD. Thirteen research questions were raised to test the PBrTF model that detailed a reciprocal relationship between CZPD, team efficacy and team flow antecedents and team flow. The following chapter explains

in detail the methodology and the overall design of research method for each of the four studies conducted as part of the thesis.

CHAPTER III: METHODOLOGY AND RESEARCH DESIGN

3 Overview

To investigate the research questions and hypotheses listed at the end of Chapter II, this thesis will conduct four studies. Listed in Table 3-1, Study 1 will aim to explore the concept of CZPD and the association between the four research variables, namely, CZDP, team efficacy, team flow antecedents and team flow core experience using a semi-structured interview. Study 2 will pilot test a CZPD scale developed based on the findings from study 1, aiming to examine the dimensionality of the items in the CZPD scale. Study 3 aims to further examine the dimensional stability of all four study variables. Study 4 tests the hypothesised PBrTF model using Structural Equation Modelling. As the thesis employed both qualitative and quantitative method, the research design is considered a mixed-method design. The next section discusses the mixed method design in detail.

Table 3- 1: Studies overview

Study	Aim	Method
Study 1	To explore the concept of CZPD and the association between the four research variables, namely, CZDP, team efficacy, team flow antecedents and team flow core experience. Also to develop the CZPD item pool	Qualitative
Study 2	To examine the dimensionality of the items in the CZPD scale	Quantitative
Study 3	To further examine the dimensional stability of all four study variables	Quantitative
Study 4	To tests the hypothesised PBrTF model using Structural Equation Modelling.	Quantitative

3.1. A quantitative mixed method design with a pragmatism philosophical perspective

In line with the proposed model, this research project plans to employ mixed methods as general design. A mixed design combines both qualitative and quantitative approaches in the investigation of the same phenomenon within one or more studies (Onwuegbuzie & Leech, 2006). Studies with a mixed design look into a research interest from the same theoretical perspective (Creswell, Plano, Gutmann & Hanson, 2003), in the case of this study, it is the development and testing of the PBrTF model. As a result, although seen as distinctive scientific research approaches, studies using a combination of qualitative and quantitative design enjoy a richer and integrated interpretation and a better understanding of complex issues in reality (Mack, Woodsong, MacQueen, Guest & Namey, 2005). These advantages entailed in a mixed design can be summarised into five different functions (Gary, 2014): (1) triangulation validates qualitative results with quantitative ones, offering corroboration for the findings (Doyle, Brady & Byrne, 2009); (2) complementarity elaborates or clarifies the results from one approach to another, giving enhanced interpretation of the research question; (3) development advances the findings in one approach with the aid from other; (4) initiation compares the results from both approaches to reveal contradictions or paradoxes in the data, which lay the foundation for new perspectives and new questions; (5) extension employs both approaches to widen the depth and breadth of the research inquiry (Caracelli & Greene, 1993; Onwuegbuzie & Collins, 2007).

Qualitative and quantitative methods makes different philosophical assumptions (Greene, 2008). Researchers using qualitative approach make knowledge claims from a constructivist and interpretivism perspective, which argues that reality is socially constructed and there is an interactive association between the researcher and the object of research (Creswell, 2003; Sale, Lohfeld, & Brazil, 2002). The primary goal of qualitative research is to identify themes and/or develop theory using open-ended data. Methods employed in qualitative research often pertains to archived documents, interviews, focus groups and participant observation, etc. The analysis of these data often includes grounded theory, thematic analysis, phenomenology etc. (Merriam, 2002). Quantitative

methodologists, on the other hand, often hold a post-positivist perspective, which involves cause and effect inference, using of measurement and observation to test theories (Creswell, 2003). Therefore, using quantitative method, the observer is separated from the research subject and the investigation is rather objective. The primary goal of a quantitative study is using numeric data to infer relationships between variables.

The distinctive philosophical stances between the quantitative and qualitative research paradigms challenges the attempts of mixing these two frameworks (Greene, 2008). However, the mixed methods advocates such as Tashakkori and Teddlie (2003) argue that mixed method should be regarded as a separate methodology distinct from quantitative and qualitative method. Johnson, Onwuegbuzie, & Turner (2007) argues that the primary philosophical stances of mixed-method design is pragmatism instead of positivism or constructivism. To this end, Johnson et al. (2007) propose the qualitative-quantitative continuum as illustrated in Figure 3-1. The continuum shows that a mixed-method design can be considered as qualitative mixed, quantitative mixed or a pure mixed method. In other words, as long as it is a combination of qualitative and quantitative study, it is no longer a mono-method design (Leech & Onwuegbuzie, 2009). The above discussion argues that a mixed-method design takes the advantages of both quantitative and qualitative methods, taking a pragmatism perspective to advance scientific research by building an integrative picture of the world. Adopting such a pragmatism philosophical perspective, this thesis employs four studies to explore and develop the PBrTF model. As only study 1 is qualitative in design, this thesis uses a quantitative mixed research approach.

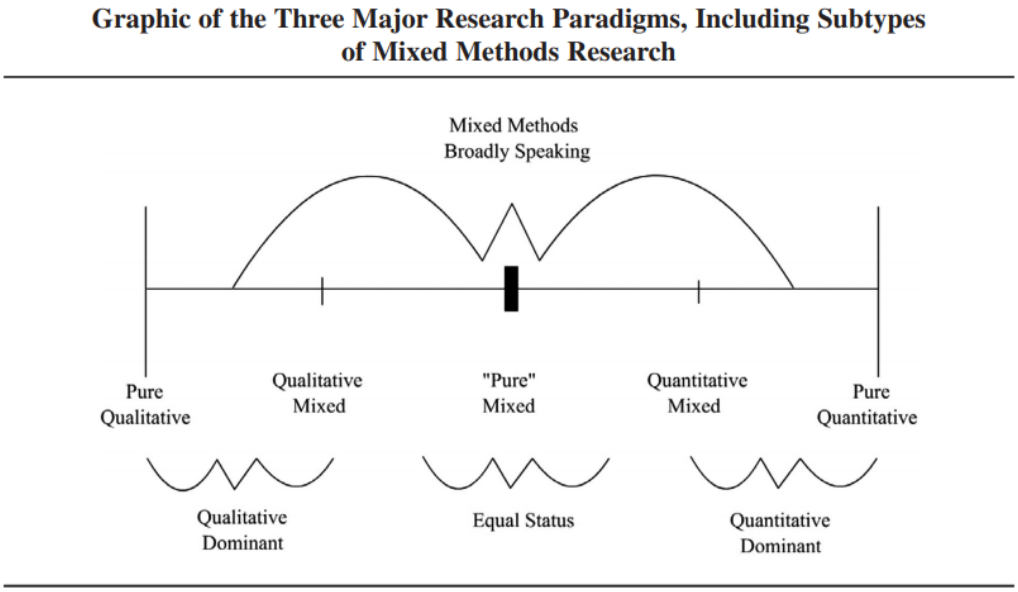


Figure 3- 1: Mixed methods design continuum. (Adapted form Johnson et al., 2007)

3.1.1 The development focus and the research design

Johnson & Onwuegbuzie (2004) argue that a true mixed-method design must mix and integrate the findings from different studies at some point. The design of the study method in this thesis aims to combine the findings from the four studies mainly for the development and advancement of the PBrTF model both theoretically and practically. The ultimate goal of this thesis is to use this tool to develop team effectiveness. Discussed in the previous section, the third function of mixed method design is the development, which aims to advance findings from one approach with the aid from other. Accordingly, this project is broken down into four empirical studies, each one is built on the findings and information from the previous one. Following a quantitative mixed-method design, the four studies each serve related yet distinctive functions in the investigation and development of the proposed PBrTF model. See Figure 3-2 for an illustration of the overall design.

Specifically, the first study aims to explore project team members' experience of their team collaboration processes based on the five characteristics of CZPD, namely idea interaction, decentralised control, diversity, redundancy and organised randomness. Also, this study seeks to investigate the participants' experience of the emergence of CZPD, team efficacy and team flow and the perceived association between the three phenomena. As CZPD is an

underdeveloped construct and its potential contribution to team effectiveness remains at a theoretical level, study 1 employs a qualitative research approach to collect initial empirical evidence. The researcher collected data using semi-structured interviews and the interview schedule was developed based on the proposed frameworks from existing literature. Apart from the research finding, an item pool of CZPD was developed based on the literature and the research findings from study 1. Therefore, study 1 mainly serves to clarify and develop the relevant concepts.

Based on the findings from the first study, the second study aims to develop and pilot testing this item pool of CZPD questionnaire. This study utilises Mokken Scale Analysis as a quantitative approach with a cross-sectional design, collecting data from potential participants who have had teamwork experience to pilot testing the dimensionality of CZPD and the scalability of the items.

Study 3 aims to investigate the cross-time dimensional stability of all the measures will be used in study 4. Because the Study 4 utilises a longitudinal design, it is necessary to establish the dimensional invariance (see detailed explanation in Chapter VI) of the measures over time to improve the accuracy of the parameters in the structural model. Considering the potential sources of instability introduced by the time-lag of data collection, this study explores the interindividual difference, intraindividual differences and intraindividual changes in the data using Mokken Scale Analysis.

Using Structural Equation Modelling, the fourth study examines the structural relationships between the variables proposed by the PBrTF model. To examine the proposed causal relationships between the variables, this study employed a longitudinal design, collecting data from two time occasions, once at one week after the start of the participants' team project, and once at one week before the end of their team project to ensure that all participating project teams are measured at similar measurement occasions.

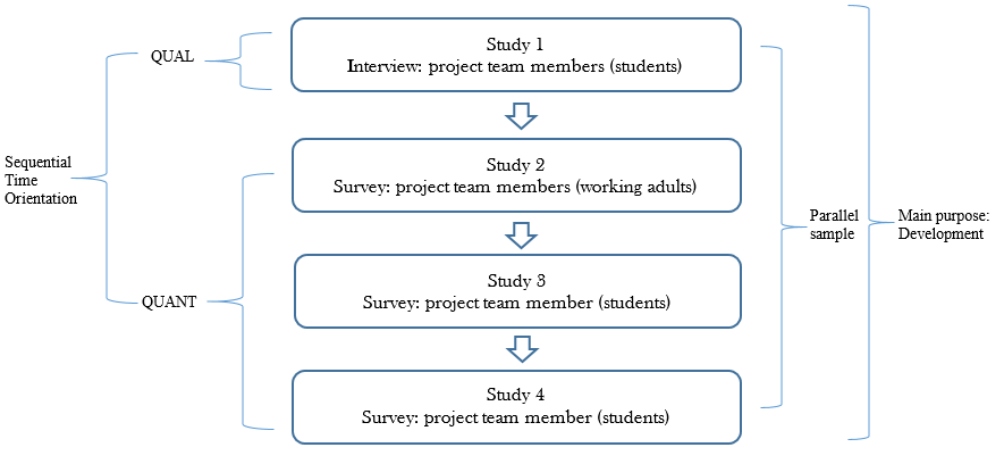


Figure 3- 2: Overall research design.

3.1.2 The data collection strategy and data sources

Taking into account of five main functions served by the mixed method design, the data collection procedures followed two criteria, namely the origin of data and time order (Onwuegbuzie & Collins, 2007). Origin of data refers to the relationships between qualitative and quantitative data, which can be (a) identical when data are collected from the same sample using both methods; (b) parallel when data are collected from different samples sets in the same population; (c) nested when one approach collects data from the subset sample of another approach or (d) multilevel when no less than two sets of data are collected on different levels (ibid. Time order simply explains whether data of different approach are collected simultaneously or in a sequence. It is referred to as a concurrent time orientation if the qualitative and quantitative data are collected at the same time. It is defined as sequential data collection if the data is collected one after another.

Greene, Benjamin and Goodyear (2001) argues that the decisions made on the time orientation and the origin of data are all related to the research purposes, which are the five functions of mixed methods discussed in section 3.1. For the purpose of triangulation, a concurrent time orientation is recommended in order to converge, corroborate the results from both methods. For the purpose

of complementarity, both concurrent and sequential time orientation can be useful in order to elaborate, enhance and clarify a phenomenon. A sequential time orientation is recommended if the purpose of the study is development, which looks to develop a study by building on the findings of the previous one. For initiation, both concurrent and sequential design can assist to identify paradoxes and contradictions. For expansion, it is recommended that sequential time orientation can facilitate in extending the breadth and range of the investigation.

As illustrated in Figure 3-2, as the main purpose of this thesis is development, the overall research design of this thesis can be seen as a sequential data collection with parallel data origins. This research employed sequential data collection mainly because the findings of the previous study informs the design of the next one. Also, this research used parallel data origin, sampling participants who were all from the population of members of project teams. Such a design improves the consistency of the findings using different methods and enable an integrated interpretation.

The participants are mainly from two sources: students working on team projects from the University of Nottingham, and working adults working on team projects. Specifically, the researcher identified the participants for study 1 by looking through the University of Nottingham module catalogue. The participants were considered as suitable candidates because their team projects were designed to simulate the project teamwork in a real-life consultancy firm. The participants were asked to form small consultancy teams to solve business problems for their company clients. The company clients are officially registered real business firms with offices in Nottingham. They operate in all walks of industries including the automobile, the textile, the food technology etc. Therefore, to ensure that each team is presented with a unique problem that requires thorough investigations, in their initial meet-up, the representatives from the companies presented their business problems to the student project team who are asked to undertake jobs such research, data analysis etc. to produce a business plan or marketing report as the result of their work. Therefore, the participants were considered suitable for the research purpose. See detailed participants description in study 1.

The participants of study 2 were recruited by posting study advert on online social media platforms, including *Tweeter*, *Facebook* and *Call for Participants*. The online survey they were directed to from the study advert requires that the participants need to be adults who were involved in team projects or that they had been involved in team projects within the past year. The participants worked in a variety of occupations, see study 3 for a detailed description.

Study 3 and Study 4 used the same dataset. The participants were all students from the University of Nottingham. The researcher used the same method as in study 1, identifying the participants' courses from the university online catalogue. The researcher contacted the course convenors whose students were required to finish team projects for permission to access the potential participants. The data were collected using a paper-pencil based questionnaire. These participants were from different disciplines, for a detailed description see study 3.

3.1.3 Overview of data analysis strategy

According to Green et al (2001), the data analysis strategy of mixed-method research can be summarised using a time-oriented framework as the parallel track and the crossover track. Using a parallel track, data are analysed separately and in the final stage, conclusions and inferences are drawn by comparing and connecting the results from each approach. The crossover track is more interactive. The researcher summarises and transforms the results from one method to another for further analysis and processing.

This thesis uses a dual approach. For the development and testing of the overall PBrTF model, the mixed method data analysis strategy adopts a parallel track, analysing data separately in study 1 via semi-structured interview and then in study 4 using Structural Equational Modelling. The results are discussed and integrated in Chapter VIII. For the development and testing of the CZPD construct and scale, the research adopts the crossover track transforming the results from study 1 to develop an item pool, which is tested in study 2 using a

quantitative method. Study 3 further tests this scale before it could be used in the final analysis. See a detailed discussion of the CZPD scale validation process in Chapter VIII.

3.1.4 Mixed method research quality criteria

The quality of research inference of mixed-method research is judged on both the traditional qualitative and quantitative research criteria (Winter, 2000). Therefore, for the quantitative components, the study is evaluated by statistical reliability and validity (Lacity & Janson, 1994). For the qualitative components, the results is evaluated in terms of its trustworthiness and rigour (Golafshani, 2003). In other words, the qualitative part should be conducted based on its philosophical perspectives that emphasise coherence of method, appropriateness of the sample, theory integration and development and concurrent data analysis (Morse, Barrett, Mayan, Olson, & Spiers, 2002). While mixing these two approaches in one research, Bryman, Becker and Sempik (2008) proposed three general criteria for methods integration. Specifically, mixed-method researchers need to make sure: (1) that the chosen mixed method is relevant to the research purpose; (2) the research procedure of the mixed method is transparent and that (3) the findings of mixed methods are integrated, not left as distinctive parts.

Combining the recommendations discussed here, the general mixed method is applied in the overall design making sure that the mixed approach is relevant to the overall research purpose. See detailed discussion in section 3.1.1, 3.1.2 and 3.1.3. In the final discussion chapter, the findings of all four studies are integrated to produce a coherent discussion. Also, in each study, clear and sufficient description of research methods and analysis technique is provided to ensure the transparency of the mixed methods. Specifically, this thesis will apply the qualitative research criteria for study 1, and building on the constructivist stand to ensure method coherence, sample appropriateness, concurrent data analysis and theory integration and development as is discussed in Morse et al. (2002). See detailed discussion on research design and data analysis strategy in study 1. For study 2, 3 and 4, the researcher will follow quantitative criteria for statistical validity and reliability for construct development and model fit. These quantitative and

qualitative research criteria will be applied in each individual studies. A detailed discussion of research design and data analysis technique are presented in study 2, study 3 and study 4.

3.2 Ethical considerations

This research follows the British Psychological Society ethical guidelines (BPS code of Ethics and Conduct, applicable form 2009), BPS Code of Human Research Ethics (2010), Ethics Guidelines for Internet-mediated Research (BPS, 2013), and the Data Protection Act 1998. This thesis had received ethical approval from the Medicine & Health Sciences Research Ethics Committee from the University of Nottingham (Ethics Reference No; LT08022016 SoM PAP) on 26th February 2016. This research followed the ethical procedures and principles which requires that the participants should be kept free of harm and informed that their responses would be kept anonymous and confidential. The researcher provided all participants with the research information sheet and consent form and ensured that all participants knew that they have a right to withdraw without having to give a reason and their involvement is entirely voluntary. For a detailed description of ethical conduct refer to the specific empirical chapters of study 1, 2, 3 and 4.

3.3 The development of the CZPD questionnaire

After study 1, as part of the research objective, a 43 item pool of CZPD was developed. The process of scale development is reported here.

Although CZPD was proposed by Goos, et al. in 2002, it has not been appropriately operationalised. Therefore, based on an extensive literature reviewed in Chapter II and integrating the insight of the discussions about effective self-organising systems, team dynamics, multi-level theory, and the qualitative empirical findings in Chapter IV, a CZPD item pool covering the five conditions proposed by Davis & Simmt (2003) has been developed (see Chapter II and Chapter IV for detailed discussion). The researcher has invited an English language educator, an applied psychologist and six people with project teamwork

experience to evaluate the face validity of the items wordings. Through an interactive process of item generating, revising, comparing and refining, a 43 item 7 point Likert-scale system were selected to depict the CZPD content domains identified from both the literature and the results from the qualitative study. Each element of CZPD has several indicators summarising its core nature. See Table 3-2 for the items and their corresponding dimensions.

Table 3- 2: Dimensions and sub-dimensions with corresponding items

Main themes	Subtheme	Items
Idea interaction	Ideas sharing	1. When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation). 2. When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas
	Ideas clashing	3. When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement 4. When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.
	Ideas integration	5. When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.
Decentralised control	Authority of action correctness	6. One or a few member(s) take a directive role in your team. 7. The development of your team project strictly follows an approach decided by one or a few members. 8. There is only one way to carry out your team project. 9. There are only one or a few members of your team with the authority to decide on the way to carry out your project. 10. The end-product of your team project is mostly influenced by requirements from outside the team (e.g. clients' requirement, industry regulation etc.). 11. A more knowledgeable and skilled member took a leading role in carrying out the project. 12. The quality of the project would suffer without the contribution of one or a few

		members who are more knowledgeable and skilled. 13. The end-product of the project is the outcome of a collective effort.
	Shared task as the centre of attention	14. The decision-making process is based on the requirement of the team task. 15. All team members collectively decide on the way to carry out this project. 16. The end-product of your team project is the outcome of a collective decision-making process among team members. 17. Members have the freedom to influence the end-product.
Redundancy	Shared task-related know-how	18. Your team was established with a clearly defined task. 19. Your team was established with a broadly defined task. 20. Attention and activities of the team are centred on the development of the end-product. 21. The team has a clear overall objective that all members know in advance. (e.g., the team knows what is to be delivered in the end.) 22. Members share a set of standards for how a task should be conducted. 23. The requirements of the project are sufficiently specific. 24. The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry specific language and terminologies, jargons, etc.). 25. Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.) 26. All members have clearly defined responsibilities. 27. If one member is unable to accomplish the allocated task, other members are able to finish it instead.
Diversity	Role diversity	28. Members' roles are self-assigned. 29. Members' roles are imposed. 30. Members stick to the same roles throughout the project. 31. Members are free to take on different roles under different circumstances.
	Expertise diversity	32. Members contribute ideas and/or suggestions voluntarily. 33. Team members are equally skilled peers. 34. Individual contributions add to the diversity of ideas within the team. 35. Members of my team are diverse in terms of our ranges of interests.

		36. Members of my team are diverse in terms of our ranges of expertise.
Organised randomness	Liberating constrains	37. The nature of the task allows for freedom to explore new options. 38. The nature of the task leaves us little space for experimentation. 39. We gained a sense of ownership of the end product. (end-product: the outcome of the team task)
	Progressive elaboration	40. The development of your team project followed a pre-determined set of action plans or procedures. (e.g. planning, etc.)(R) 41. The development of your team project unfolds on it's own/takes its course. 42. The standards of quality for your team project develop over time. 43. The end-product of your team project was predictable before it began.

With this new scale, this project, alongside the objective of developing and testing the PBrTF model, also aimed to develop and test the scale of CZPD and complete the initial validation process. The development of a new scale required careful and systematic investigation. Wright, Quick, Hannah, & Hargrove (2017) published eight best practice recommendations for scale construction in the context of organisational research. (See Table 3-3 for a list of the recommendations). Their article aims to offer a framework for the development of scales that add clear and significant value to their respective fields. Wright et al. (2017) emphasises that scale validation is a process aiming at establishing a nomological network of the construct. This process is ongoing, demanding the test of multiple samples from different contexts and the development of a rich item pool.

Fundamentally, as the operationalisation of constructs, scales must be based on sound theoretical frameworks. I have used a hybrid approach in the data analysis. The development of the CZPD item pool have mainly followed the "logical partitioning" or "classification from above" practice, which is a type of scale development approach that requires the researchers to map out a logic framework in advance of data collection (Hinkin, 1995; Hunt, 1991). In addition, to best exploit the richness of the data, a data driven approach was also employed to allow new themes to emerge (Fereday & Muir-Cochrane, 2006). Opposite to a deductive approach, the data driven approach allows themes to emerge from the

data and does not try to fit the data with the pre-existing theory or framework. In Chapter II, I have followed the best practice recommendation No.1 and established a theatrical framework of CZPD. Integrating the perspectives from Vygotsky's (1978) ZPD model, the complexity theory of self-organising entities, Kozlowski et al.'s (1999) team compilation model, and Davis & Simmit (2003)'s article about the self-organising learning system, we have developed the theoretical groundings of CZPD and identified five features underpinning this collective breeding ground for continuous peer-learning and unit effectiveness. Our literature review and the theoretical framework posit that the five aspects of CZPD is related to the emergence of team efficacy and team flow. This theoretical grounding is the basis for item generation and content validity (Schriesheim, Powers, Scandura, Gardiner, & Lankau, 1993). Up to this point, the development of CZPD has followed recommendation No.1 and No.2. Study 2, 3 and 4 will contribute to carry out the initial validation process of CZPD by following the best recommendation No. 3, 4, 5, and 6. Due to the scope of this thesis and the research design of the studies, this thesis does not carry out the recommendation No. 7 and No. 8. A discussion summarising the initial validation process is presented in Chapter VIII.

Table 3- 3: Best practice recommendations for scale development (Wright, et al. 2017).

Best practice recommendation No. 1	Provide a theoretical justification for each scale item.
Best practice recommendation No. 2	Devote proper attention to initial scale development and content validity
Best practice recommendation No. 3	Pilot test the preliminary scale
Best practice recommendation No. 4	Conduct an item analysis, factor analysis, reliability analysis and validity analysis of the preliminary scale
Best practice recommendation No. 5	Assess reliability, validity and factor structure of the revised scale in a new sample
Best practice recommendation No. 6	Establish criterion validity
Best practice recommendation No. 7	Report confidence intervals for all reliability and validity coefficients
Best practice recommendation No. 8	Assess scale bias in the final version of the scale

3.4. Chapter summary

This chapter has discussed the nature and essence of mixed method and explored the suitability of this method to the research questions put forward in Chapter II. Based on the research strategy discussed in section 3.1.3., the next four chapters present the four empirical studies beginning with study 1.

CHAPTER IV: STUDY 1 CZPD AND ITS ASSOCIATION WITH TEAM FLOW AND TEAM EFFICACY

4 Overview

This study aims to investigate project team participants' experience by exploring the team collaboration processes based on the five characteristics of CZPD. Additionally, this study also looks into the participants' perceived associations between CZPD, team efficacy and team flow. Specifically, the interview focuses on exploring the participants' experience of their teams' organising structure, the frequency and manner of communication. Also, the interview aimed to explore their evaluation of their teams' skill and knowledge base. By forming an idea of their teams' CZPD status, the study also aims to investigate the perceived relationship between the emergence of team flow, team efficacy and CZPD. The study comprised eleven semi-structured interviews with business school Masters students who had completed team project assignments less than two weeks prior to interview. The data were analysed using thematic analysis, and the implications of the findings are discussed. A reflexivity section of this study is also presented in the end.

4.1 Study design

This study was qualitative in nature. The researcher has conducted interviews with the participants asking questions listed in the Interview Protocol in Table 4-1. Each interview session lasted about 30 minutes. The data were analysed using a thematic analysis.

4.1.1 Sample and Procedure

The interviewees comprised eleven Business School Master's students from the University of Nottingham. They were invited to participate because they had recently engaged in a long-term team project that lasted for three months. The exclusion criteria is team with less than two people. They were required to form a

project team with two other teammates to provide consultancy services to a client company and provide them with a final report which also served to fulfil part of the requirements of the course assignment. In addition to this report, they were also required to conduct a formal presentation of their work to their client company and their course convenors. All of the client companies are real-life businesses which differ in size and industries. As a small project team, they acted as a small business consultancy group, providing services in the form of marketing research or business plans to solve problems for their clients. Because participants were in teams of only three members each, and with whom they had to collaborate closely for three months, they are considered as suitable candidates to share experiences of working in peer-learning self-organising teams. Although the company projects they were required to complete were part of a course assignment, their clients were real businesses owners who had brought real business problems for the teams to solve, and can thus be representative of the context or environment of a typical project team in organisations.

The researcher approached the course convenor to circulate an invitation email to targeted students, which detailed the purpose and procedure of the study. Email invitations to participants were sent between March and May 2017. Students who volunteered to participate were instructed to read the information sheet and sign the consent form before the start of the interview session. The interviews took place between the third week of May and the first week of June 2017.

Participants were from diverse educational and cultural backgrounds and the teams are usually comprised of members from diverse backgrounds. The ages of the participants ranged from 22 to 28 years old. Four are female, nine males. The participants came to the University of Nottingham from different countries, including India, Nepal, Madagascar, Austria, Indonesia, Malaysia, Singapore and the UK. Although they were all registered on the same Master's course, they had different undergraduate backgrounds. Nine of the students studied business-related courses such as finance and marketing, whilst four of them came from an engineering background. Participants were allocated to clients with businesses of different sizes and different industries, ranging from automobile, textiles,

technology to biotechnology, and were thus able to offer insights into the team collaboration experience from different perspectives.

The interviews were conducted in a meeting room in one of the university buildings, which provides a safe and secure environment. The interview protocol was designed to elicit information about all five aspects of the CZPD construct. Questions regarding participants' experience and attitudes towards CZPD, team flow and team efficacy, and their opinions on the associations between theses constructs are also incorporated in the protocol. See Table 4-1 for detailed interview questions. The interviews were audio-recorded using a digital recorder. The data were transferred to the researcher's computer and stored in a password-protected folder. The researcher transcribed and coded the data using the qualitative data analysis program of NVivo v.12. after the completion of transcription, raw data was destroyed for ethics concerns. The researcher analysed the data using thematic analysis (Guest, MacQueen & Namey, 2011), in which themes emerge from the data and are grouped and analysed.

4.1.2 Ethical considerations

Adhering to the British Psychological Society's Code of Ethics and Conduct (BPS, 2009) and the Data Protection Act 1998, the researcher conducted the interviews with prior ethics approval from the Medicine & Health Sciences Research Ethics Committee from the University of Nottingham (Ethics Reference No: LT08022016 SoM PAP). After gaining access from the gatekeeper, who was the course convener of the participants' module, the researcher arranged interview meetings with the participants. The researcher provided all participants with the research information sheet and consent form before the interviews took place. The researcher also discussed relevant ethics issues with the participants, reassuring them that the content of the interview will be treated with strict confidentiality, the recordings of the interview will be destroyed after the completion of the research, and the transcripts will be kept anonymously with all identifiable information removed. No professional transcribing service was employed.

4.2. Research questions

The purpose of this study is two-fold. First, to explore the emergence of CZPD in team collaborations. As a less investigated concept, CZPD is still in its infancy and needs the support of further empirical evidence for its conceptual refinement and application. Although there have been studies exploring some form of CZPD (Armstrong, 2008; David & Simmt, 2003, Gaggioli et al., 2015) and its relationship to team effectiveness, the evidence accumulated so far does not provide direct support for the construct of CZPD and its relationship with team efficacy and team flow. For example, while exploring group flow using video observation, Armstrong (2008) assumed that the participating teams were operating in a learning system similar to CZPD. In Gaggioli et al., 2015, only two elements of CZPD, idea interaction and decentralised control, were examined using social network analysis in a crossectional correlational analysis. As such, more systematic investigation on CZPD and its impact on team effectiveness are warranted.

Additionally, because CZPD has its origin in ZPD (Vygotsky, 1978), which is one of the most recognised social constructivist learning theories, it has only been discussed in an educational context. Therefore, the scope of its theoretical application is limited. For the same reason, its application is very much concentrated on the teacher-student collaborative dynamic. Therefore, I proposed to investigate CZPD and its five conditions in a simulated work-related environment, expanding its application to peer collaboration in an occupational setting.

Moreover, the relationship between CZPD, team flow and team efficacy has never been investigated directly. As an optimal collective state, team flow has received much attention. However, apart from Salanova et al. (2014) which investigated how team efficacy as a team level resource contributes to the emergence of team flow, I know very little about the regulation and monitoring of team behaviour as a resource to facilitate the emergence of team flow.

As such, I conducted this qualitative interview study to explore the nature and features of CZPD in the context of a quasi-workplace environment. Although the participants in this study are Masters Students, and their team projects were graded as an assignment, the teams acted as consultancy services commissioned by business clients. The executive summary the teams produced at the end of the module were submitted to their clients and put to business use. As such, interviewees were considered suitable for the purpose of this research.

This research asks the following questions:

1) *How do the teams organise their interactions in terms of the five characteristics of CZPD, namely idea interaction, decentralised control, diversity, redundancy, and organised randomness?*

2) *Does a team's CZPD have an association with the emergence of team efficacy and team flow?*

4.2.1 Research method

4.2.1.1 Semi-Structured interview

Semi-structured interviews were utilised in order to explore the experiences of project team members in terms of their perceptions regarding the five aspects of CZPD and their associations with the emergence of team efficacy and team flow. Semi-structured interviews are particularly suitable for the research because of their inherent capacity to explore experiences and understand attitudes, values, opinions and processes (Rowley, 2012). In other words, semi-structured interviews help the researcher explore a phenomenon or a particular experience descriptively, providing gateways to an in-depth understanding on a subject, especially when it is less known and less well-researched (Stephens, 2007). Although there has been some research done on team efficacy and team flow (Salanova et al., 2014) CZPD is a relatively new construct that needs further theoretical refinement. To this end, although commonly considered as time-consuming both for the interviewer and the interviewee (King, 2004), a semi-

structured interview approach was deemed appropriate for the research objectives of this study.

4.2.1.2 Development of the interview questions:

Based on the suggestions from King (2004), the interview questions were developed taking into account of the relevant literature, the interviewer's knowledge and preliminary work. The researcher constructed the interview questions based on the literature discussed in Chapter II and the discussion on the team lifecycle (Kozlowski & Bell, 2013) and multilevel theory (Kozlowski, 2015) discussed in Chapter I. See Table 4-1 for an Interview Schedule below.

Table 4- 1: Interview schedule

Questions (prompts in italics)
Internal diversity: Do you think you and your teammates are different in terms of your expertise background and experience? *what makes you think so?* Do you think you and your teammates provide suggestions and/or ideas based on their unique expertise and experience? *could you describe such an incident?* Do you think you and your teammates take on roles voluntarily based on their unique expertise and experience? *Could you describe such an example?* Do you think the diversity in terms of expertise and experience in your team makes your work more innovative and/or more efficient? *How do you think it worked?*
Redundancy: Do you think you and your teammates share necessary task-related knowledge? *For example, project goals, terminologies, and shared understanding of the task etc.* Do you think this shared knowledge makes your team collaboration more coherent and/or effective? *Could you give an example of it?*

If someone is for some reason unable to finish his/her allocated task, do you think other teammates would be able to fill-in? *Has this happened in your team?*
Decentralised Control How do you make a decision in your team? *For example, do you make a collective decision or is there one person who decides?* If there is something that you are not sure of, do you discuss with your teammates or do you follow one person's order? Is there someone in your team you all go to for approvals? Do you work towards the shared task goal or do you feel obeying the order of the overseer is more important?
Idea Interaction Do you and your teammates often share ideas and offer suggestions? *Could you describe such an incident?* Do you often engage in discussions and analyse and interpret each other's suggestions? *Could you describe such an incident?* Do you think the end product of your project is a combined output of all member's contributions? *Can you tell which part of the outcome belongs to which member?*
Organised randomness Do you think the assignment specification gives you and your team the opportunity to explore different options? *Does the task specification prescribes a clear boundary of actions or does it encourage you to explore?*
Team flow, CZPD and team efficacy Have you had any memorable moments in the project? *Have you and your teammates experienced moments where you feel you are extremely concentrated and you know exactly what to do next?* What makes this moment occur? *What were you all doing at this moment?*

Did you think your team could successfully carry out the task? What made you think so?

4.2.1.3 Thematic Analysis

Following the method described in Braun and Clarke (2006), thematic analysis was conducted. Thematic analysis is considered a flexible qualitative data analysis technique that is particularly suited for the purpose of identifying and analysing emergent themes in qualitative data (Braun & Clarke, 2006). Therefore, as there is little known about the phenomenon of CZPD and its relationship with team efficacy and team flow, thematic analysis is considered as the most suitable method to explore the research questions in this study. Through an iterative process, the thematic analysis identifies the common themes that emerge from the data and analyses and interprets the findings in association with the research topic (Tuckett, 2005). Because thematic analysis is flexible and easily accessible, this technique might suffer from the possibility of misinterpretation of findings due to lack of objectivity. Moreover, the analysis is also criticised for not being transparent (Smith & Firth, 2011). To tackle the possible drawbacks and safeguarding the quality of the data analysis, Braun and Clarke (2006) recommended a six-step procedure to organise the data analysis process. The researcher followed the six steps to analyse the data and produced the thematic grid in Table 4-2:

(1) The first step is *familiarisation*, which recommends that the researchers immerse themselves in the data starting with data transcription immediately after data collection. This step ensures that the researcher could note down the initial thoughts and impressions freshly after the interview. In this stage, the researcher listened to the audio records of the interview and finished the transcription. The transcription was read through several times while making annotations in the process.

(2) The second step is *initial code generation*, which involves the creation of codes that reflect a semantic or a latent property. A semantic

code commonly identifies an explicit meaning while a latent code represents underlining meanings. Initial codes, which outlines the meanings of different transcript sections, were generated by comparing the annotations made across the transcripts.

(3) The third step is *theme searching* where researchers group interrelated codes into initial themes. Fereday & Muir-Cochrane (2006) advised that themes can be purely data-driven or fully theory-driven or a combination of both. This step can be facilitated by the use of tables or thematic-maps. Because interview questions were organised using the five aspects of CZPD (i.e. idea interaction, decentralised control, diversity, redundancy and organised randomness) by Davis and Simmt (2003), the same five aspects as the pre-existing nodes were used to structure the themes.

(4) The fourth step is *theme reviewing* where the initial themes are being refined. The refinement of the initial themes needs to consider the relationships between the extracted codes and the data as a whole. As a result of this process, the original themes would be grouped as the main themes and sub-themes (Aronson, 1994). Initial themes and subthemes were re-worked through an iterative process of collapsing, deleting and refinement in order to make sure that there is sufficient and meaningful evidence supporting each theme.

(5) The fifth step is *theme defining and labelling*, where, after the researcher's understanding has deepened, she starts to redefine and refine the names of the themes. This process is aimed at giving the themes more appropriate names that encapsulate their essential meanings (Braun & Clarke, 2006).

Specifically, "idea interaction" and "decentralised control" are the behavioural aspects of the notes created. Idea interaction is further given the child notes of *ideas sharing*, *ideas clashing*, and *idea integration*. "Decentralised control" is given the child notes of the *authority of action*

correctness, and *shared task as the centre of attention*. "Redundancy" and "diversity" are used as the cognition aspects of the notes. "Redundancy" is further specified with the child notes of *performance criteria clarity*, *shared know-how*. "Diversity" was given the child notes of role diversity, idea diversity, and background diversity. "Organised randomness" as the complex emergence aspect of CZPD was not given any child note as it does not have any sub-aspects. Apart from the themes of CZPD, another theme covering the perceived connection between team flow, team efficacy and CZPD was created. This was coded as the associations between team flow, team efficacy and CZPD. A reflexive journal was kept for the analysis. See Table 4-2 for the finalised themes.

(6) The sixth and final stage is to *report.* The researchers finish the analysis and report the result in this sage. This report details the emerged themes with data extracts as illustrative examples.

Table 4- 2: Table of themes and subthemes.

Main themes	Subtheme	Description
Idea interaction	Ideas clashing	The process of clarifying disagreements and misunderstandings to improve mutual understanding.
	Ideas sharing	The action of sharing and contributing one's idea to the team.
	Ideas integration	Combining member's ideas to generate a better idea.
Decentralised control	Authority of action correctness (defined in 4.3.1.2)	One member dominates the decision-making process.
	Shared task as the centre of attention	The decision-making process is based on the requirement of the team task.

Redundancy	Shared task-related know-how	Members share a clear understanding of the team task goals and performance criteria. A shared understanding of the task-related knowledge that enables the members to be able to compensate for the loss of a member or a member's failure.
Diversity	Role diversity	Members voluntarily assume different roles based on their own skills and expertise.
	Expertise diversity	Individual members have a variety of expertise that extends the range of the team's skill reservoir.
Organised randomness	Liberating constrains	The task requirement is broadly defined with a clearly defined outcome expectation but no constrains on the process to achieve the end goal.
	Progressive elaboration	These nature and essence of project tasks, implying an ongoing process of task defining and redefining goal setting and clarifying solution forming and refining.
Team Flow	Synchronised	This type of team flow is characterised as cohesion and redundancy oriented.
	Frictional	This type of team flow is characterised as innovation and diversity orientated.
CZPD, team flow and team efficacy		The emergence of CZPD is associated with the emergence of team flow and/or team efficacy.

4.3. Findings and discussion

4.3.1 CZPD

4.3.1.1 Idea interaction:

The results suggest that idea interaction has three subthemes: ideas clashing, ideas sharing and ideas integration. Ideas clashing happens most often when there is a disagreement in the team or there is confusion. On such an occasion, team members communicate with each other to work through their opposing ideas. The purpose of such a process is to clarify the root of their differences and achieve a better understanding. Idea clashing might sound like conflict, but, is actually a useful feedback process for the improvement of individual learning and team performance. Here, participant #5 gives an example of idea clashing when members disagree with each other and how this serves as a feedback process that improves their performance:

> *"when sometimes we disagree with each other, you can say it's a conflict but it's a positive conflict, it actually appears mostly when we were writing up our report, for example, I wanted to put some finance data in the report, the other member did not agree with the idea, he thought it's confidential information, I showed him it's not confidential it's all available on the internet."* (Participant #5)

> *"...it was intense when we were proofreading the report, we were constantly asking each other why did you put in this part, why is that not included. And we would explain to each other. The feedback was really helpful. When you do things individually you don't critically justify your action. So the team helps. We collectively figured out the right things to do."* (Participant #5)

Members contribute to the project development by voluntarily sharing their ideas to the team. The idea-sharing process is often facilitated by the diversified nature of members' expertise. Participant #2 describes how his

teammates draw on their diversity in expertise but making collective decisions through idea integration:

> *"...because of my background, I have done a marketing degree, that was a lot of essay writing, for me it wasn't too bad because I have got a lot of previous work that I can just take the structure from, and they had an engineering background, so we split it up and I have my section and I know what I was doing and I trust that my teammates were doing what they need to be done. So the only time we would need to meet up is after we've done our individual bits, we need to make sure that our work is coherent and run nicely, so we just came together and run it over and make some tweaks. So once we've put it together, we meet up and we all read it and we kind of have a discussion of what we think needs to be done and the changes we need to make, in general, and then one teammate makes sure that the document runs well but before that, I think we all read it through, make necessary tweaks."* (Participant #2)

Without consistent idea sharing, it is easy for the team to lose sight of their task goal and fail to accomplish their mission. Participant #6 has a teammate who is disengaged from the team most of the time and this lack of idea interaction with the rest of the team members damaged his own performance and the team's as a whole:

> *"...he missed the task... sometimes what he's done is not right or not appropriate. There's the description, but he doesn't do it. And he did another thing, he's constantly missing targets, he doesn't get the point but he doesn't ask, then when he proposed his work and then oh my God is all wrong. It's like, you know, (our client) has given us this question to be answered but you answered another question...so I and the other team member have to redo his work, that's challenging."* (Participant #6)

Idea integration is a process that often follows idea-sharing and idea clashing. After a team has accumulated diversified ideas and found a way to appreciate the value of opposing suggestions, the team has enough resources to

integrate and merge different ideas to generate a solution that is best suited to tackle the problem at hand. It is worth noting that although idea sharing, idea clashing and idea integration are seen as different types of activities, they often happen within in the same discussion session and the process can be interactive. Participant #10 described in detail how she and the other two teammates approached idea sharing and idea clashing, and how this helped them understand and learn from each other their mutual learning process:

> *"We help each other on what to do...I'm very straightforward and you know when I say something and um she was like oh you mean like this? You know, if she doesn't understand. Because she is very communicative in a way. Or let's say um when another teammate said something and maybe she does understand that. So I will draw something on a paper (to show her) and it's like that way it works very well...I mean we don't have the official results yet but, um we were actually able, I think each of us, to contribute equally, and to be like welcome feedback and stuff like that. And the communication I think is very important."* (Participant #10)

Participant #3 described how one idea led to a positive development through active idea interaction during a meeting:

> *"...at the beginning it was slow because we are getting our thoughts together and it's everywhere, once someone threw in a useful idea, and we interact with that thought and idea and the meeting just gets to further level and another level, it seems like it is going somewhere..."* (Participant #3)

4.3.1.2 Decentralised control:

From the data, decentralised control has mainly manifested in two ways: the shared authority of action correctness and shared task as the centre of attention. The data suggests that a team has a shared authority of action correctness when every member can have a say in the decision-making process. When the team is faced with a difficult situation and not sure what to do next, any member with

previous experience or expertise in this specific area can take control and suggest a solution. As an example of shared authority of action correctness, participant #5 described how every member in his team participated to control the project development process based on individual expertise:

> *"We had different leading patterns; sometimes, the three of us became leaders at different time. But in three different areas. For example, I was the one to ask questions in the meeting with the client, and the rest just took notes. It was not a leadership role but somehow, I lead that way. And when it comes to solving the problems, another member, he was very good at it. He was very good at preparing the excel file. He single-handedly beat up this excel file, so he took leadership in solving the problem, we helped him giving him ideas and everything. When it comes to the preparation of the report, he also took leadership. When communicating with the manager, she (the third member) was communicating with him. We were all leaders to some extent."* (Participant #5)

The same pattern of the shared authority of action correctness emerged in participant #7's team:

> *"If three of us agree on something, but if we can't decide, someone would come in to make the decision. Sometimes if this guy had more experiences he would just step up and say OK, let's just do it this way. Or when we are confused about something and I have experience, I would just say OK, I have seen that before, let's just do it this way. It depends on people's experience. "* (Participant #7)

In addition to this decentralised or distributed leadership, the team puts the task at the centre to guide their actions and decisions. In the event where members have a strong disagreement, the team would refer back to the task guidelines or requirements to make a decision. Thus, the team makes sure that they have the task at the centre of everyone's attention and the task requirement overrules any dispute and guides decision-making.

"... when we have conflict, we go back to the instruction on how to solve the problem and how to write the report. So when I'm not sure if I'm giving the right idea, I just withdraw my idea. Sometimes, when he thought he's not right he would withdraw his idea. It often comes with logical reasoning, when he disagrees he gives reasons. I often do the same." (Participant #7)

Most participants agree that they don't want to work in a centralised team or under a dominant person. This is similar to distributed leadership where because everyone has a say, all members are equally engaged and motivated. This shared authority is based on members' equal status with diversified skill sets and knowledge. In other words, no one is far more experienced in everything than the rest of the team. For example, for participant #11, domination is demotivating:

"In our project, there was one guy who was very dominant and didn't want to accept any critics. He was absent for two discussion sessions, so we created the idea and then he came on the third station and said well this is not good and he wanted to change the whole idea and he was very dominant and even though he didn't do anything he just killed our idea. He was very hard to convince. I tried with the best of my communication skills and agreed that we will follow some of his ideas but in the end, he disappeared again...(in this situation) you're not motivated because you don't feel that your opinions are appreciated." (Participant #11)

Participant #8 feels that domination also makes the team narrow-minded, although the team spend less time working on their project:

"We were more effective when I was in the team with a dominate person, we spend less time every time we met together but we missed many things, we tend to judge too quickly with one problem and in the real world I think its dangerous, I don't think our solution would be as effective." (Participant #8)

Moreover, a centralised team that operates under the control of a dominant figure can demotivate the members because they do not feel valued and appreciated. Team effectiveness can also be damaged because domination breeds power struggle.

> *"There were a lot of complaints and a lot of bitching and kind of talking behind people's back. So people in this team were all motivated to do something slightly different but because there is this one person who was like no we are doing this, it really showed in their presentation. The presentation was awful, it fell apart, it was properly just because they didn't get along. And they didn't agree on what to do and I think if you don't agree on what to do, you just won't put your 100% into it."* (Participant #2)

An over-experienced member might become the authority figure in the team, and the rest of the members grow to rely on him/her for decision-making and action correctness. This overreliance hinders the team's ability to learn and evolve, which would have a negative impact on the team's performance. This is exactly what happened in participant #6's team, which because of overreliance, the team was not able to proceed once the authority figure was absent. Members are reluctant to explore more possibilities. In participant #6's team, there is one person who was far more experienced. The team was not able to progress because they over-relied on his instruction:

> *"...like you know he has the brightest idea, but also the most complicated ideas. But because he travels a lot so we have to wait for him, just like wasting time and we cannot do anything anyway."* (Participant #6)

4.3.1.3. Diversity

The data suggests that there are three subthemes of diversity: role diversity, idea diversity and background diversity. A team is considered to have a role diversity when members voluntarily assume a variety of different roles based on

their expertise or preferences. Participant #2 describe how role diversity emerged in his team on the basis of expertise diversity of the members:

> *"We had so much collaboration we do not need a specific role. The roles were not set up, we know where we stand in the team and we know our capability so the role is just naturally the way it is."* (Participant #2)

In participant #5's opinion, role diversity happens in a similar manner when the team moves on to the next task, role diversity naturally transfers to the next stage. People find their own suitable roles in different circumstances.

> *"...we assign ourselves homework to understand more, so one member went to understand their business more, one worked on literature review. It's not like someone divided the work, we divided it ourselves. Later on, we move on from the HR problem to the business plan, someone is looking for one area and other is working on something else."* (Participant #5)

Expertise diversity can give rise to role diversity. Often, a team's range of expertise diversity delineates the boundary of its performance. In other words, the expertise diversity of a team represents the team's maximum level of intelligence. For example, in participant #11's opinion, expertise diversity played an important role in the team's success. It is perceived as the key to success:

> *"...I think that the key importance of success is that we have covered all three important expertise needed for the project...the different team expertise, I think it's a key factor."* (Participant #11)

Similarly, participant #8 provided an example of expertise diversity based on people's background. In his experience, members naturally pursue a direction based on expertise and the fact that the expertise is diversified contributes to the width of their understanding of the task. Although two subthemes emerge in the analysis, role diversity and expertise diversity are interconnected. Role diversity

can derive from expertise diversity and a role diversity can reinforce an expertise diversity when, over time, individuals find their most suitable and comfortable position in a team.

> *"I don't know to what extent but I think my background affect me a lot. For example, when we talking about the technology, I tend to think about the performance of the technology, because I know about some biological processes, so we interviewing the company, I tend to address the performance aspect of the technologies. But the other guy doesn't care about this. He cares about why the customers don't want to buy this product."* (Participant #8)

4.3.1.4. Redundancy:

Redundancy refers to a common task-related knowledge base that is necessary to facilitate communication and coordination in a team. It is the opposite of team diversity. This common ground includes a shared understanding of performance criteria, the task goal, the convention of performance, domain-specific terminology etc. that enables members to coordinate resources and compensate for each other's absence or failure. Redundancy is the basis of coherence, promoting the team compilation process described by Kozlowski and Bell (2013) by fostering team relationship bonding, which promotes engagement and ultimately enhances performance. Many participants have given examples illustrating how common task-related knowledge and skills could facilitate member engagement, communication, relationship bonding and task performance:

> *"...actually everyone participated, we all took part, everyone knows how to do a SWOT analysis and other terminology, it's like a default knowledge base."* (Participant #4)

> *"when there are things that not all members understand, like terminologies, we would explain it to each other, but once we all understand what it was, it helped our communication"* (Participant #5)

"the terminology (differences) would have been an issue if this was at the beginning, but because we have done several projects together and this is already the second semester, they have already been brought up to speed." (Participant #2)

Similarly, in Participant #1's opinion, as soon as the team is familiar with how to conduct their teamwork, they would be able to cover up for each other in order to finish the team task.

"Yeah, we were like not at the very start, but once we got to start, when we got the hang of how we do things, we might be able to compensate. Sometimes it's like, uh, let's say I'm ill or maybe I say that I have some work today. I cannot make it on this day. What should we do? And one of the team members would be like, uh, it's not a problem. We two can carry on. We can replace each other when needed." (Participant #1)

4.3.1.5. Organised randomness

Organised randomness is defined as a team's structural response to the nature of the task requirements. Organised randomness includes two subthemes, one is liberating constraints, which describes the nature of the team tasks, and the other is progressive elaboration, which emphasises the evolutionary nature of project team processes. When a team is functioning with organised randomness, it is capable of balancing its diversity and redundancy because the nature of the task allows the team to find a set liberating constraints that define a space of possibilities. This is similar to the flow element of "merging of awareness and action", which describes a mental state of intense concentration and optimal performance that the person who is in flow is not aware of. Therefore, organised randomness often signifies the emergence of a complex system. However, organised randomness as the emergence of the team's unit-level competency is difficult to observe at an individual level, especially for a participant of the process. As a result, organised randomness is manifested as two observable elements: liberating constraints and progressive elaboration.

According to Davis and Smmit (2003), organised randomness emerges while the task requirement is a set of liberating constraints which is neither proscriptive nor prescriptive. The traditional notion of the nature of task requirement sets prescription and proscription at the two poles of a spectrum. On the one end, prescription emphasises a strict rule-based nature with a detailed and specified process as well as outcome expectation; on the other end, proscription emphasises a ruleless exploration. In other words, a prescriptive task requirement is redundancy orientated while proscriptive tasks are diversity orientated. Because liberating constraints allow the freedom to explore and experiment within a set of boundary conditions, which are determined by the task goal, the emergence of organised randomness can therefore have the room to balance diversity and redundancy. The following two example illustrate how liberating constraints encourage process exploration and innovation, with a broad outcome expectation and only low-level rules constraining the boundaries of activities.

> *"...there is a guideline but they give us so much freedom to do it because every group has a different journey, there is not a structure, we had to come up with that ourselves."* (Participant #11)

> *"The company (client) give us a clear job description, like, you know for example, we have to do market research for this company. And then we have to answer their question. But for the solution, we can go with anything. Sometimes (this freedom) feels like a workload, but it gives me the freedom to give my idea, that it's good. Pretty good."* (Participant #6)

For progressive elaboration, the interviewees described the evolution of their team process. Based on the guidelines given, their teams followed an iterative process of problem-finding and problem-solving. The teams adapt their tactics and strategies along the way to figure out a unique way of dealing with the problems that were presented for them. Participant #3 gives two examples of progressive elaboration:

"The sense of the direction I mentioned, it's not the path we were taking, it's the end goal. We know what we were supposed to achieve because the company (client) has already given us the project. So we know that's where we want to get. In the beginning, because this was a new industry for all of us, as we had no idea, we went along, we evolve, we learned. For example, it took us a couple of months to get the first ten responses for the survey, but the rest of the ninety responses we got it in a few weeks. That's how we roll out and evolve along the way, we found the key resource to tap into. There's never a straight path, it's always a zigzagging. You might have a basic idea in the beginning, we roughly know we were supposed to carry out primary research, but we didn't know who to talk to." (Participant #3)

"The content of the report was not what I envisioned it. Because when we first took on the project we were very sceptical about the product that the company had made, so our initial club meeting, it was fairly early stage still, when we went out to talk to the customers, it seem that there's no market for the product, it's hopeless, might as well just move on with life. But because the company insisted, so we think of different ways to find customers and different sectors and different ways to interact with them, it's definitely not the way we envisioned at the beginning. It seemed really negative in the beginning, but as we evolve we found, OK! There's seems to be a lead there." (Participant #3)

The data suggests that all participants agree that their task requirements fit the description of liberating constraints. Mostly, they are given a problem to solve or an end goal to achieve, but the teams are not limited by how to solve the problem. There are no constraints on the process and this freedom is perceived positively by participants. As a result of the latter, the teams were able to explore and experiment with different possibilities. Through a progressive elaboration process, teams work out the boundaries of activities on which they can balance the team's redundancy and diversity -- the emergence of organised randomness. Interestingly, progressive elaboration is not an aspect of organised randomness originally proposed in Davis and Smmit (2003). As discussed in Chapter I,

progressive elaboration characterises an essential feature of project tasks that describe the ongoing process of task definition and redefinition, goal setting and clarifying, and solution forming and refining (Project management Institute, 2013, p.552) . The interviewees often describes an iterative process as a result of the freedom they had to explore different possibilities in their project. Adhering to the guidelines given, the interviewees described their team process as a zigzagging process of evolvement and, along the way they were able to adapt their tactics and generate unique solutions and innovative products. As a result of the liberating constraints, a team actualises organised randomness through progressive elaboration. Progressive elaboration is therefore seen as an irreplaceable element of organised randomness that signifies that liberating constrains has been implemented and started functioning.

4.3.1.6. The emergence of CZPD: the interaction between CZPD elements

The findings above serve as examples of the themes and subthemes derived to describe the five individual elements of CZPD. However, CZPD elements do not just appear separately; oftentimes, when the interviewees describe their team collaboration, the five elements often interact to facilitate the emergence of an equal status collaborating system. For example, in participant #3's description, he and his teammates used to engage in intense discussion and debate, especially when they do not agree with each other. This is a common occurrence of active idea interaction. However, what immediately follows idea interaction in his team is a decision making phase where members make a collective decision based on logic and as a consequence of their idea interaction. Therefore, their decision-making process is based on decentralised control where the team puts the task as the control centre:

> *"We are all stubborn to an extent, which is good because we all think differently. You don't want a team that thinks all the same, but when it comes to making a rational decision, you put your own feelings aside, OK this is what we going to do. We compare and contrast our ideas and decide which one is the best one to go."* (Participant #3)

Participant #4 gave a similar example. Her team progresses with their project in an iteratively interactive process between idea interaction and role diversity.

> *"So after a discussion, we would generate some ideas together so we know what we are going to do with each part of the project. And then people just pick the part that they are good at to finish; for example, there is digital marketing with Google, Facebook, or Job Site. And then we all go home to finish our allocated part and then in the next meeting, we continue to discuss and decide what to do collectively".*

The data suggests that a team often engages in idea interaction when members try to come up with a solution to a problem. The range of possibilities of this discussion depends on the range of diversity the team has. In the example given by participant #3, members engaged in an intense discussion because they all have different point of views to offer, which help the team avoid the danger of group thinking and expanded the possibility of solutions. Although members all have strong feelings about their own ideas, their discussion did not turn into a conflict or hit an impasse because the team is regulated by decentralised control. As participant #3 described, after discussion and especially when the disagreements cannot be resolved, the team would make a collective rational decision based on logic and the task requirement, putting the task at the centre of the team's attention and leaving personal feelings aside. Redundancy plays a role here as well because a shared clarity and understanding of the task requirement and performance criteria outlines the boundary of the project. Granted, the same is possible in centralised teams which are controlled by a dominant figure. However, in this case, idea diversity would have a hard time to manifest and the centre is not the team but the dominant figure. In this example, the team found a balance between redundancy and diversity where they relied on the team's expertise diversity to explore possibilities, and when it came to decision-making, they resorted to redundancy—the shared understanding of their task. This balance is a manifestation of organised randomness. Operating under a set of liberating constraints, the team learns and grows and progresses through progressive

elaboration that is characterised by idea interaction and decentralised control. This cyclical process of progressive elaboration is even better demonstrated by participant #4's example. After making a collective decision based on the redundancy of shared task know-how and decentralised control, role diversity emerges when the members in participant #4's team go and pick up a part of the project based on individual expertise diversity. The team met again the next morning to decide collectively what to do next after a new round of discussion and idea interaction. The above example shows how, a self-organising entity adapts and learns and grows following an iterative process in which the five elements of CZPD continue to interact. As a result, a team is considered to have evolved into a smart and effective entity when it is capable of taking the advantage of both its collective intelligence, which is defined by the range of its diversity, and its redundancy, which is its basis for coherent collaboration. When the team is able to maintain a good balance between diversity and redundancy contingent on the type of task it is engaged in, organised randomness emerges as an active idea interaction governed by decentralised control. Therefore, the interaction between the five elements is key to the emergence of CZPD, the social breeding ground for a peer learning.

Davis and Simmt's (2003) original conceptualisation of a complex learning system focused on the nature and feature of these five elements separately. Although they did not explicitly propose the possible relationships between these five elements, they have emphasised that a collective intelligence, i.e. CZPD, is capable of striking a balance between its resources of diversity and redundancy according to the changing dynamic of the demand of their task. This intelligent entity maximises the use of diversity and redundancy through the freedom of idea interactions but also maintains its order and focus by exercising decentralised control. The analysis and synthesis of the evidence the interviewees provided in the above discussion illustrated how the elements of diversity, redundancy, idea interaction and decentralised control is interdependent of one another and interplay and interact within the boundaries set by organised randomness, which defines the nature of the task and the process of the project. The evidence presented here and the conceptualisation of the emergence of a collective intelligence by Davis and Simmt (2003) both indicate that the five elements of CZPD do not function independently. In other words, it seems that the formation

and functioning of these five elements are driven by the same underlying phenomenon, which is the emergence of a collective intelligence. Following this line of reasoning, the question put forward in section 2.4.3 about the dimentionality of CZPD. This line of reasoning suggests that, it is possible that CZPD might be a unidimensional construct with five aspects. However, further empirical research is need.

4.3.2 Team flow, CZPD and team efficacy

The data quoted above is a selection of the participant's description of CZPD elements and how CZPD emerge as a result of the interaction between the elements. The interviewees also provided examples illustrating the association between the emergence of team flow, CZPD and team efficacy.

4.3.2.1 CZPD and the two forms of team flow

The interviewees reported a team flow like experience primarily during two occasions: presentation and discussion. In presentations, team flow has been described by participant #8 as a feeling of the team becomes "one" because during the presentation the team is treated as a single unit, and their work is seen as the result of the collective effort. The team was focused on delivering their collective product. This feeling is a response to feedback from the outside of the team.

> *"... particularly when we were presenting the job in front of the company. We felt we were in one team because we talked about everything we wanted to speak about and we agreed with each other...Because it's the only report, it will be marked for the three of us, and that often happens when we were about to present as well because they see us as one."* (Participant #8)

But mostly, the feeling of team flow is derived from within the team. For example, participant #7 reported a team flow like experience when members' coordination was highly synchronised during their presentation. He described a scenario where one member turned over the slides at the precise moment when

his teammate who was presenting finished the last sentence on the slide. In his view, such synchronised movement between team members happens as naturally as listening to a song, where one intuitively knows the tempo and rhythm of another teammate's speech. This synchronisation is similar to the "merging of awareness and action" dimension in the original flow model (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009), which regards this element as one of the deepest forms of flow experience. Participant #7 reported that this sense of synchronisation was enjoyable for him:

> *"We help each other during the presentation, for example, we turn the slides when is needed... You subconsciously just know OK he's part is going to end here... When you focused on that part you just know, if you listen to a song you'll know that the song is going to come to an end now...well you don't tend to focus on that when you are presenting right? It's just a natural thing to happen. But looking back on it, it's nice (laugh)."* (Participant #7)

Participant #2 gave the most comprehensive description of the team flow experience, emphasising the characteristics of productively, enjoyability, synchronisation and fragility:

> *"I think there are definitely moments when you just click and you are in the zone of working very productively as a team. I think that's very rare. I think we have had two or three moments as a team during this project where we know what we are doing, we are on the same page, it's quite nice."* (Participant #2)

> *"During the presentation, you are all in the zone, you need to present what you have done, you know where everyone is at and you were just like OK, three two one, we start. "* (Participant #2)

> *"Or during the meetup, I think when two of us were talking to one (client), we bounce off each other, and at the moment we were kind of*

locked in. I think they are very rare to come across and I think when you think about it, it's gone. It only happens quite naturally." (Participant #2)

Consistent with Armstrong (2008), Bakker (2005) and Sawyer (2007)' definition, participant #2 thinks team flow can be characterised with synchronisation, enjoyment, productivity and fragility and describes a team flow experience using the words like "click", "in the zone" and "locked-in", which are the signs of intense collective concentration. He echoed the view of participant #7, who associates synchronisation, which is a harmonious collaboration and cohesion perceived in team flow or the feeling of 'being on the same page', with a "merging of awareness and action", the deepest form of flow (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009)). In this version of team flow, the team is in a redundancy forced mode of CZPD in which, contingent on the nature of the task, the team automatically places less emphasis on diversity. As described by participant #4, the team flow experience during their presentation is a process of homogenisation because everything is finalised and clear to all members and the team focuses on integrating and merging people's thoughts. Therefore, for Participant #4, the most enjoyable moments of team flow occurred during their presentation and the preparation for the presentation:

"...when you are preparing for a presentation, all the ideas are finalised and clear to everyone. There is no more adjustments, we are all focused on how to best deliver our work. It is an integration, we merge our thoughts...it is enjoyable during the presentation especially when the course convenor is happy with your work, it's like you have successfully solved a problem." (Participant #4)

Team flow manifests a different version in discussions. In Participant #4's view, the team flow experience during their presentation was enjoyable, however, the team flow experience during discussions was not so pleasant and even felt somewhat like a struggle. During discussions, as the team was in an exploration mode, the emphasis was placed on the diversity of ideas. There had been an intense level of idea interaction and idea clashing especially during disagreements. The team might feel frustrated and somewhat stuck. Participant #2 echoed this

view and described that he felt "locked-in" with his teammate in an idea interaction phase. However, contrary to the enjoyment felt in the homogenous version of team flow that frequently emerges during presentations, this frictional version of team flow felt like a painful struggle filled with frustrations. This coincides with the Davis's (2018) notion of struggle flow, which suggests that flow or team flow is not always associated with pleasant feelings, although still strongly associated with performance, effectiveness and concentration. This frictional version of team flow is associated with CZPD when the team has switched its focus to diversity and idea generation. While a team is exploring possibilities, diversity is its basis for creativity and innovation.

> *"...when our team is discussing something, oftentimes there is a lot of disagreement, there is a friction of ideas...we are all trying to persuade and understand each other. The team is very focused and concentrated, but it is not a very enjoyable process...it is painful."* (Participant #4)

Although painful, pparticipant #4 described such a dramatic phase as the "friction of ideas" which is characterised as high level of concentration and focus, and an induced sense of "distortion of the passage of time" (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009), one of the deepest forms of flow sensation. The participant often lose track of time when she was absorbed in their intense discussion:

> *"... time passes really fast every time the team is discussing something, I don't know why but it's like we started at 12 pm and then suddenly it's 6 pm, and we have only gone through several issues. When the meeting is over, you just feel extremely tired, you don't feel it during the discussion but it actually has already been five, six hours."* (Participant #4)

From the data, it is suggested that individual flow does not have to concur with team flow. In fact, in participant #2's view, individual flow is an inward-focused dynamic while team flow is open and outwardly focused:

"I think in an individual flow, I'm just in my zone. I've blocked everything out, you know, I'm on to something and I'm going for it. While in a team flow you just got to be more open and it's about working with others and balancing ideas so it's just a completely different dynamics I'd say. Team flow is about open yourself up and you'd have to trust each other you are just working as one big unit." (Participant #2)

Participant #4's account corroborates his opinion. She reported an increasing level of self-consciousness during intense discussions and idea interactions. In this process, members receive criticism and feedback on their ideas from each other. While this exchange is a great learning opportunity, this process certainly involves much self-reflection, which is the opposite of the dimension of "losing self-consciousness" of flow (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009):

"it depends on the feedback you received really, if people disagree with you a lot in the process of idea exchange, you would reflect on your own thoughts more, it's good because you would learn what's useful what's not, but it's tiring and uncomfortable...yes we are very focused, but this process is just not enjoyable. " (Participant #4)

This is not surprising, as participant #2 emphasised that team flow is about collaboration and trust the unit. This outward-focused dynamic of team flow, which is characterised as synchronisation of thoughts and actions, collective concertation, productivity and enjoyment, is closely associated with the team's ability to effectively self-organise. While it is not conclusive whether team flow is exclusive of individual flow, it is clear that the experience of team flow is closely associated with active and effective social interactions such as CZPD, an effective self-organising structure.

The mainstream flow and team flow literature has mainly focused on the enjoyable aspect of flow. Using a data driven approach, it was found that there are two versions of team flow, the synchronised team flow and the frictional team flow. synchronised team flow is characterised as cohesion and stability orientated. Members sharing synchronised team flow report enjoyable experience

collaborating with each other. However, the frictional version of team flow is not well documented in the literature. A frictional flow emerges when a team is in a innovation or creative phase; their communication is characterised by frequent idea sharing and idea clashing. The main focus is to work through the differences. The team is highly concentrated, members' attention is locked in with the matter at hand. However, this phase is described as a difficult or even frustrating experience.

4.3.2.2. Team flow, CZPD and team efficacy

The above findings shows that the participants' recollection of a team flow experience is closely associated with the occurrence of CZPD. However, alongside CZPD, the excitement of optimal team performance and heightened concentration of team flow, participants also expressed team efficacy, i.e. their trust in the team's ability to face to the challenge. When asked how his team arranged a task, participant #1 described the emergence of role diversity in his team, in which members voluntarily pick up a role and collectively and naturally finished the task. He emphasized that the way he's team interacted and collaborated, made him very confident about the team. This confidence or team efficacy took the pressure off him as he knew that the team was capable of effective communication and organisation.

> *"...it's like again collaborative effort ..., one says: guys let's meet tomorrow or the day after for the project. And I say: Okay, let's meet at this time. And then the other one is like, ok, I'll book the room now just in case someone else takes it before us."* (Participant #1)

> *" We were actually happy. I mean if it was a different team, the effort and the stress would have been way more. We did this project without any stress ... if you work in a different team, you have this stress (you might worry what) if the member is not right, one of them is not putting in the effort. And if you cannot communicate clearly it's more like if you feel like a burden as you're dragging someone. So we didn't feel that*

because all of us were putting effort and we could communicate clearly with each other. So yeah, yeah, that's good." (Participant #1)

Team efficacy is also described in association with the emergence of high performance and team flow. Participant #2 attributed their successful presentation to their team efficacy. In his opinion, team efficacy motivated the members and led the team into a flow-like state and optimal performance.

"yeah, during the presentation, definitely. Because we got on very well with the clients and course coordinator, so we had a chat before the presentation and they know we are going to do a good job, we know what we were going to say. So the presentation went really well, it just kinda flowed. It feels good because we've worked together for so long, I know it's going to run smoothly. Everyone is intrinsically motivated." (Participant #2)

On another instance, participant #2 described how his team quickly formed CZPD and were able to rapidly adjust balancing diversity and redundancy based on the changing situations with potential customers.

"When talking to the clients and gathering information, the three teammates were talking to different people at the same time, so I would be sitting on this side of the table, one member on the other side and the third member to my right, so we were all talking to someone else but we were all kind of listening to what each other are saying, just in case you know, I understand about that, so I'll just chip in. And it's all because we wanted to get information from ten people and we can't all talk to ten people, but it just was kind nice to know what the conversation was like from someone else. And obviously, if I hear he's asked a good question, I'll be like ok that's a good question, I'll need to ask that as well. It feels really good, it's a bit nerve-wracking talking to ten strangers, but it is just good to know that because there are three of us, it's not like that all the pressure is on me, you know. We've always got each other to fall back on if it needs to be,_that felt quite nice._I think that's the moment when you kind of know that you are in a conversation but you know what's happening around you." (Participant #2)

This example shows that based on the shared common knowledge the members have about their product, they asked the customers questions in accordance with the shared understanding of the task requirement. At this stage, they were in a redundancy focused CZPD. Although the three members were talking to different people, they also paid attention to each other's needs. The team was able to quickly switch to diversity and chipped in when one member needed the expertise of another. In this situation, the team naturally switched to diversity-focused CZPD. It seems that they were able to operate in CZPD and effectively conducted their task because they were in team flow. The team members were concentrated not just in their own conversation with different clients, but they also paid attention to each other. Almost like being connected to an invisible control centre, the members were synchronised and acted as one unit. Team flow emerges as the members showed an effortless concentration and absorption, which is the hallmark of team flow (Bakker, 2005; 2008). This experience gave him confidence in the team and reduced feelings of stress because he knew they could rely on each other. This example shows that CZPD, team flow and team efficacy share a tied association.

4.4 Conclusion, implications for future studies

This study set out to explore the project teams' collaboration processes in terms of CZPD's five elements, and it also has tested CZPD's association with team efficacy and team flow. The results have provided the first empirical support for the theory of CZPD and the PBrTF theoretical frameworks developed in Chapter II. The results have also helped refine and improve the theoretical frameworks.

As mentioned earlier, CZPD is a new construct. Apart from largely theoretical discussions, CZPD is not well supported by empirical evidence. As the purpose of this thesis is to investigate the relationship between CZPD, team flow and team efficacy, this initial qualitative study was conducted to clarify and further develop the definition and comprising elements of CZPD. From analyses of the findings, it was found that although the subthemes that have emerged are not exactly the same as proposed in section 2.4, the organising structure of the

collaboration of a project team comprises five themes: namely, idea interaction decentralised control, diversity, redundancy and organised randomness. Specifically, as reported in Table 4-2, idea interaction is composed of idea sharing, idea clashing and idea integration. This theme and the subthemes confirms the conceptualisation proposed in section 2.4.3, which suggests that idea interaction characterises the frequency, density and intensity of the communication with in the team. For decentralised control, two subthemes were found. These are the authority of action correctness and shared task as the centre of attention. This is similar to Gaggioli et al., (2012) and Armstrong's (2008) finding, which suggest that the authority is distributed in the system and the decisions are made by the collective. Also confirms with the original conceptualisation us redundancy and diversity. Redundancy indicates the shared know-how of the knowledge, skills and task requirement This is the overlapped area in CZPD which serves as the basis for the stability and order of the collective entity. Diversity comprises two subthemes: the role diversity and expertise diversity. As is discussed in Davis and Simmt (2003), diversity is the root of possibility, the range of innovation and creativity a collective entity is potentially capable of. Organised randomness has two subthemes: liberating constraints and progressive elaboration. Similar to Armstrong's (2008) argument, liberating constrains are the type of task that offers the team a liberating boundary within which members can explore and experiment. Progressive elaboration was not explicitly discussed as a subtheme of organised randomness. This subtheme is the result of an inductive data driven approach. As is discussed in section 4.3.5, progressive elaboration describes iterative process in which a project team explores and experiments for different solutions.

Moreover, although the data suggest that CZPD comprises these five elements, the data also suggested that the emergence of CZPD depends on their interaction. In other words, the five elements are closely related. This poses a question on the dimensionality of CZPD. Based on the theory (Davis & Simmt, 2003), CZPD is a construct comprising multiple dimensions and each dimension describes a distinct aspect of team organisation. In Armstrong (2008)'s discussion, CZPD was discussed as a learning system that has five distinct perspectives. Seeing them as separate elements, Gaggioli et al. (2015) also investigated the relationships between team flow and idea interaction and decentralised control separately.

However, it is also possible that because of the close interdependence shared between the five aspects, CZPD can be regarded as a single dimension construct. This difference has implications for future research that plans to investigate the relationship between CZPD, team flow and team efficacy because inaccurate understanding of the dimensionality of the construct contributes to erroneous conclusions. The importance and implication of dimensionality will be discussed in study 2.

Based on the findings, I have developed a 43 item pool for the questionnaire of CZPD. Description of the development process is detailed in Chapter III. See Table 3-2 for the detailed items and their corresponding themes and subthemes. This item pool will be utilised in the subsequent study, in order to pilot the content validity of CZPD.

In addition to the theoretical refinement of CZPD, this study also found evidence to support the hypothesis that team flow, team efficacy and CZPD share a mutually beneficial relationship. Salanova et al. (2014) provided evidence suggesting that team efficacy is a contributing factor towards the emergence of team flow. Based on the SCT model, this evidence indicates that as the psychological influence, team efficacy increases the level of team flow, which is seen as an environmental influence. This work has greatly contributed to our knowledge of team flow, however, there is one element left untouched in the SCT framework---the behavioural influence. Based on the findings in this study, the researcher can reasonably argue that CZPD might be considered the missing link in this model. The association reported by the participants suggest that CZPD, team flow and team efficacy often emerge at about the same moment and that they share a strong connection. In light of these findings, I conducted model testing in study 3 and 4 investigating the potential mutually reinforcing relationships between team flow, team efficacy and CZPD.

4.5 Reflectivity

Reflexivity in qualitative research is the process in which a researcher reflect on how their own values and beliefs affect the research (Johnson &

Duberley, 2003). The qualitative research is subjective in nature because the researcher himself/herself is involved in the process of data collection and data analysis regardless of whether the data is collected through an interview or non-participative observation. This is especially the case for thematic analysis because this method is not linked to any specific theory and it is, generally speaking, suitable for any form of qualitative data analysis. However, this flexible nature has also made this method susceptible to the influence of the bias of the researcher. Therefore, it is essential that the researcher's own stance and the analytical process are made transparent for the readers (Holland, 1999). The following discussion will focus on a reflection of my motivation to study optimal team collaboration, the insight I have along the way of the research and the influence I brought to the data collection and data analysis.

.

My motivation to study optimal team collaboration is rooted in my personal believes in the flow experience and its positive impact on performance and wellbeing. I experienced flow-like state personally frequently and found that similar experience occurs while collaborating with other people as well. Although individual flow is well researched, team flow or group flow has not been systematically featured in the literature. I wanted to know what team flow is like and what enables a team to experience team flow and how that could promote team effectiveness. This curiosity has situated my research endeavour in of this thesis. After an extensive literature review, I understand that team level phenomena emerges from the lower-level interaction and an effective self-organising complex system is characterises as adaptive and fast responsive to internal and external change. This discovery was fascinating but I still feel that my understanding of teams and team flow is abstract and not in touch with reality. Also, because of the fragile and elusive nature of team flow, I had started to doubt if team flow is a real phenomenon. Therefore, I have decided that I need to see with my own eyes, what does team flow or optimal collaboration looks like. I had firstly collected video observation data recording project teams having team meetings. Although this data was not included in this thesis, it was meaningful personally for me to witness team flow unfolding during the process of team collaboration. I was convinced of the effect of team flow and its positive impact on teams' performance and wellbeing. Even as a non-participative observer who

watches the recordings in a different time and space, I felt I could share the enjoyment and intense concentration team flow brought to the participants. I remember the first time witnessing the emergence of team flow: the team had engaged in a long discussion one afternoon trying to solve a budgeting issue. Everyone chipped in ideas and collaborated in the calculation. All members had their eyes fixed on the computer screen trying to work out the numbers. When they were finally done, one member glanced at the time and cried out: "oh my god! Its already four now!" The other member replied: "yeah, we've been here for four hours already". I can still remember the shock in his voice when he said "oh my god". This scene fits perfectly with the description of the deepest level of flow experience: losing track of the passage of time and intense concentration. This observation was exciting; however, I was aware that it was just my own observation and interpretation. The literature has suggested that, to triangulate such findings, it is preferable to interview the same participants who has taken part in the video observation study. They might have alternative interpretation of their experience. However, at this point they have already graduated and left the university. It was impossible to trace them. I have therefore decided to conduct interviews with the next cohort of Business school students doing the same program. My rationale was that the new cohort students would have been subjected to the same assignment and similar contextual environment. I assumed that there would be enough contextual similarities between the two cohorts. My hope was that their reflection on their teamwork experience could corroborate or challenge my understanding and impression of team collaboration and team flow, providing insights beyond what I have concluded.

Indeed, the findings in this study has enriched and deepened my understanding of team flow and team collaboration. This includes the team flow and collaboration outside the meeting room. For example, the team flow experience participant #3 described when their team went to gather data was quite different from that they had in a meeting room. The participant enjoyed their team collaboration at that time the most because the team members were all extremely concentrated and responsive to each other's needs as that was the only time they could gather their customers' opinions on their products. I believe that the participant was in a flow state while telling me about this team flow moment they

had experienced. In fact, his moment of excitement and concertation was so strong and contagious, I was brought into an interpersonal flow with him. Like the synchronisation of thoughts and action of team flow described in Armstrong (2008), I finished his sentence when he was searching for the word to describe how his teammates helped each other when asking their clients questions. I said: "so you were like each other's wingman". Immediately, the participant laughed and said: "exactly, we were like each other's wingman!". Like what I observed in the videos, there were many memorable moments in the interviews such as this one help me understand team flow and team collaboration and the impact on team member's emotion and wellbeing a lot better.

My enthusiasm and understanding of team flow have influenced how I targeted my participants and the process of data collection. The influence of the participants' believe and understanding has also shaped how the interview went. I have targeted the Business School students on the course of MSc Entrepreneurship based on the assumption that entrepreneurs normally have strong intrinsic motivation, high openness to new research and a pro-social orientation. My thoughts were that these characteristics might make them a sample that are prone to experience and talk about flow. For example, I remember enjoying one interview very much because the participant was familiar with the flow concept. I felt particularly excited during and after the interview because his description of the situation and his feeling of their teamwork fitted the theory very well, which gave me confidence in the importance of my project. Also, my background in business management studies has made it easier to communicate with business students. As the interviewer, I find it easy to understand and situate myself in their stories when they talk about scenarios such as budget calculation, or marking plans etc. This is a positive influence of interviewing like-minded people, as it is easy for the interviewer to understand and interpret data more accurately. However, the negative side of this is that, because of this like-mindedness, there potentially were fewer chances to discover new information or to be sensitive to contradictory evidence. In other words, both the interviewer and the interviewee might be blind to useful information emergent from in the process, especially when both the interviewee and I assumed that we could understand each other well.

Through this qualitative study, I have come to appreciate more how important it is for the researcher to reflect and be open about their experience and process of data collection and analysis because it is impossible to separate the finding from the influence of the researcher and the participant. The goal of qualitative research is, therefore, not to try to be objective but to expose the subjectivity of the researcher, including their motivation, influence and insights. In this way, the readers and the researcher can start to appreciate and interpret the findings in a holistic manner, taking into account the "footnotes" of the research journey.

4.6 Chapter summary

This chapter used a mixture of deductive and inductive qualitative approach to analyse semi-structured interview data to test and develop the concept of CZPD and its association with team efficacy and team flow. The results from this study will be discussed in combination with the other three studies in this thesis in Chapter VIII. As a result of this research, a 43 item pool of CZPD has been developed and the next chapter is a pilot study conducted as an initial examination of the dimensionality of CZPD. The item pool development process is reported in section 3.3 in Chapter III.

CHAPTER V: STUDY 2 SCALABILITY AND INTERNAL CONSISTENCY OF CZPD – A PILOT STUDY

5 Study overview

The result of study 1 reveals that CZPD is a phenomenon that emerges in a team as a result of the interaction of its five aspects, namely idea interaction, decentralised control, diversity, redundancy and organised randomness. Similar to the theoretical proposition, the result also shows that team effectiveness, CZPD and team flow are closely associated with one another, supporting the proposed PBrTF model. However, to empirically test and generalise this result it is necessary to first operationalise the construct of CZPD and establish an initial validation of its construct validity. In this study, the pool of 43 items developed for the CZPD questionnaire in the previous study is subjected to quantitative analysis for the first time. This study aims to test the psychometric properties of CZPD using Mokken Scale Analysis (MSA), which is an ordinal measurement model based on item response theory (IRT). MSA is more appropriate than factor analysis to examine the latent structure of Likert-scale items in that it provides a more accurate analysis of dimensionality and item scalability.

5.1 Study design

The CZPD pilot questionnaire was administered as a cross-sectional online survey that explores the five aspects pertaining to the organisation of a peer-learning social collective -- a project team. The CZPD pilot questionnaire was advertised for twelve weeks on social media platforms, including *Twitter, Call for Participants, and Facebook*. Potential participants with a current and past working experience in a project team were invited to take part.

5.1.1 Sample, procedure, and the measure

After obtaining ethical approval, the data used in this pilot study was collected using Bristol On-Line Surveys, an online survey distribution system,

between June 2017 and September 2017 in the UK. The CZPD pilot questionnaire contains 43 items reflecting the five aspects of the organisation of an effective peer learning collective. These aspects include idea interaction, decentralised control, diversity, redundancy and organised randomness. (See Chapter II for a detailed discussion; See Appendix B for the full list of items and the survey). Before taking part, all potential participants were asked to confirm that they are currently or have been involved in teamwork or a team project that requires them to collaborate with a group of people within the past year.

Because Mokken Scale Analysis focuses on positive associations between items, the negatively worded items were recoded. Listwise deletion for the missing data was employed as Mokken Scale Analysis does not evaluate cases with missing values (Van Schuur, 2011). After initial data cleaning procedures, the total number of complete and valid responses were N=209, of which 74.6% (N=156) were female. Specifically, 48.8% (n=102) were from the UK, 23.4% (N=49) Asian, 13.9% (N=29) European, 6.2% (N=13) American, 6.2% (N=13) African, and 1.4% (N=3) Australian. Almost half 48.4% (N=101) were aged between 24 years and 33 years, 16.3% (N=34) is between 18 years and 23 years, 17.7% (N=37) is between 34 years and 43 years. The participants were on average well-educated, 53.1% (N=111) had a masters level education, 20.6% (N=43) had a college or undergraduate level education. 24.9% (N=52) were educated at a PhD or equivalent level. The participants were from a wide range of professional backgrounds, 31.6% (N=66) were in healthcare professions, 21.5% (N=45) in business-related industries, 14.8% (N=31) in academia, 2.4% (N=31) in technology, 5.7% (N=12) in education, 2.9% (N=6) in engineering and 21% (N=44) in other industries.

5.1.2 Ethical considerations

The Faculty of Medicine and Health Sciences Research Ethics Committee at the University of Nottingham reviewed and approved the study. Also, this study strictly follows the Code of Ethics and Conduct of the British Psychological Society (BPS, 2009), BPS Code of Human Research Ethics (2010) and Ethics Guidelines

for Internet-mediated Research (BPS, 2013). In addition, the collection and handling of the data are in adherence with the Data Protection Act 1998.

The data were collected using the on-line questionnaire survey platform of Bristol On-Line Surveys. This system separates the IP addresses of participants from their responses to preserve anonymity. All data were handled and stored in line with data protection regulations. Participants were fully informed of their rights and the data handling procedures in the participant information sheet, which was presented prior to completing the survey (See Appendix B for the information sheet, consent form and the CZPD questionnaire). Each participant was required to confirm their understanding and agreement to participate in the study in the participant consent form.

5.2 Research questions

This chapter aims to develop a measure of CZPD and establish its content validity, dimensionality and internal consistency. Using the data collected, this pilot study plans to demonstrate the initial results of the scalability of the CZPD questionnaire and to understand its psychometric properties better.

CZPD is a newly developed measure reflecting team members' evaluation of the nature of their team's self-organising and peer learning quality. It is in theory characterised by five aspects: idea interaction, decentralised control, diversity, redundancy and organised randomness. However, the distinctions between the five aspects discussed so far are only theoretical. As was illustrated in the discussion of the construct in Chapter II and in study 1, the five factors of CZPD are closely related to one another. They are mutually influential and interdependent in the sense that CZPD can be considered as a unidimensional construct. Therefore, CZPD can be conceived in two different ways: either as a unidimensional model, or a multiple dimensional model. Although the theorisation identified five distinct aspects in CZPD, it is possible that some of these distinctions are not empirically justified. In other words, in principle, if the data suggested that CZPD was not unidimensional, it is possible to find a 2, 3, 4, or 5 etc. dimensional structure.

A unidimensional CZPD would reflect that individuals' views towards their team's collaborating efficiency is driven by a single broad evaluation, not from five distinct perspectives. If this characterised the latent structure underlying the 43 items, team members would see the quality of team collaboration as a stand alone phenomenon. This would imply that interventions can be designed to address CZPD as a unified phenomenon. However, if CZPD turns out to be a multiple dimensional construct with two, three, four or five dimensions, interventions need to be designed so as to address the various aspects individually. In terms of further analyses, if the set of items contains multiple dimensions, composing a single total score of CZPD in further analysis will not be appropriate, becayse such a score would not yield an unequivocal ordering of participants. Instead, CZPD should then be measured as separate scores on multiple sub-scales. Therefore, considering the two competing propositions of the theoretical structure of CZPD and the potential discrepancy in the practical and theoretical implications, it is imperative to examine the underlying dimensional structure of CZPD.

Therefore, based on the above discussion and the literature review reported in Chapter II, the research questions of this study are outlined below:

Research question 1: Do the items in the CZPD pilot questionnaire reflect a single-dimensional latent structure or multiple dimensions?

Based on the preceding discussions, it is hypothesised that CZPD reflects a single-dimensional structure (H1).

5.3. Mokken Scale Analysis -- A Theory of Data and Analytical Strategy

Overview

5.3.1 The nature of survey data and the risk of over-dimensionalisation using factor analysis

Likert-items are ordered-categorical survey items representing dichotomous, multiple categorical or polytomous response format (Sijtsma & van der Ark, 2017). Using factor analytical techniques such as EFA and CFA on this type of data are not appropriate as they violate central factor analysis assumptions of metric data and multivariate normal distribution (van der Eijk & Rose, 2015). In other words, such data are better suited for analysis using procedures tailored to categorical responses items. The choice of analytical techniques, which may or may not be appropriate in view of the characteristics of the items to be analysed, has profound impacts. van der Eijk and Rose (2015) conducts a systematic assessment of the current studies applying factor analysis on ordered-categorical survey items and find that more often than not when factor analysis is applied to true uni-dimensional Likert items, the results will lead to a rejection of a uni-dimensional model. The use of inappropriate measurement models would invalidate the bases of subsequent analyses. Van der Eijk and Rose (2015) summarised such consequences in four ways.

Firstly, over-factoring leads to unjustifiable conceptual distinctions. In the case of a large item pool, over-dimensionalising fragments a construct into smaller components which will then be interpreted with substantially different meanings. This error could result in redundant paths in further analysis, which takes away the conjoined meaning of a construct that is not the equivalent of the simple aggregation of spurious sub-dimensions. In the case of small item pools, factor analysis might produce a single dimension with a few seemingly irrelevant items excluded. Although the result is uni-dimensional, the factor is still measured less accurately.

Second, over-factoring also damages the comparability and replicability of a construct across different populations. For example, when the same measurement tool is administered to two populations with different distributions of individual scores on the latent dimension(s), factor analysis could yield different results in samples from the different populations even if a true single dimension exists for both. In this case, an analyst might conclude that the construct behaves differently across populations and even attempt to interpret the results accordingly. On the other hand, when applied to populations with similar latent distributions

of respondent positions, factor analysis might demonstrate similar results because of the comparability in observed correlations. However, the validity of this replication is not necessarily a reflection of the true latent structure either.

Third, when a true unidimensional construct is being over-factored, or when relevant items are deleted on the basis of results from inappropriate measurement procedures, it reduces the reliability of a latent measurement or its discriminatory power.

Fourth, over-factoring also has a damaging effect on practices over and abovethe negative consequences over-factoring on theories and statistical inferences discussed above. When a practitioner bases his/her conduct on 'evidence' that includes analytical artefacts such as over-dimensionalisation, the negative implications extend to the real world. For example, a potentially dangerous situation might arise when psychiatrists, nurses or GPs use a questionnaire with Likert-scale items to diagnose patients or to assess the effectiveness of interventions. In such a case, inaccurate construct dimensionalisation can lead to potentially life-threatening error. Also, although less lethal, similar problems could influence marketing decisions or large scale economic strategies when judgements were based on results of Likert-scale questionnaires designed to measure consumer behaviour or to evaluate experimental results. Therefore, unjustifiable conceptual distinctions or the lack of replicability caused by over-factoring may result in large scale monetary losses. In the context of policymaking, over-dimensionalisation could cause detrimental problems such as inefficient or even counter-productive policy recommendations.

As the survey items used in this project are all Likert-scale items, the considerations discussed above led to the choice of Mokken Scale Analysis (MSA) to evaluate the latent structure and psychometric properties of the scales of CZPD, team flow and team efficacy.

5.3.2 IRT models and Mokken scale analysis (MSA)

Item Response Theory (IRT) are latent variable models that focus on continuous uni-dimensional latent variables or traits that are being estimated from categorical indicators, which can be dichotomous or ordered-polytomous (van Schuur, 2011). IRT has its roots in social attitude measurement, modern psychological and educational assessments, and is particularly suited for analysing the so-called single stimulus data reflecting dominance relationships which may bebinary or ordered-polytomous . These dominance relationshipscompare two kinds of units and demonstrate that one is better, stronger or superior to the other. According to Coombs (1964), single stimulus data reflects a heterogeneous relationship between different sets of units involved, for example, participants on the one hand and IQ test items on the other (one may also think of, e.g., consumers and products, etc.). The branch of IRT that focuses on dominance relationships are known as cumulative scaling models. Mokken Scale Analysis assesses empirical data in terms of such a cumulative model; it is nonparametric in character, and therefore ideally applicable to Likert-scale items.

Mokken scale analysis is a stochastic technique developed for the analysis of latent dimensionality of sets of dichotomous or ordered-categorical items (Mokken, 2011; Sijtsman & Molenaar, 2002; van Schuur, 2011). Although similar in its aims to factor analysis (both Exploratory Factor Analysis and Confirmatory Factor Analysis), MSA is better suited to analysing categorical data such as Likert-scale items. MSA analyses the structural connections between responses to questionnaire items. When items can be combined in a so-called Mokken-scale, this indicates that the responses to the items are driven by the same underlying phenomenon. Analysts that recognise the non-metric nature of dichotomous or ordered-categorical items sometimes use factor analysis based on tetrachoric or polychoric correlations (instead of the standardly used Pearson product-moment correlations, which require restrictive assumptions of latent normality that are often highly implausible). Without assuming such a restriction, MSA, on the other hand, preserves important psychometric properties and avoids producing distorted results (Hattie, 1985), which is also it's advantage over its parametric counterpart IRT models (Andrich, 1978; Embretson & Reise, 2000).

Using a range of psychometric analytical methods, MSA assesses the fit of the monotone homogeneity model (MHM) and the double monotonicity model (DMM), which are two essential IRT models (Emons, Sijtsma & Meijer, 2007; Sijtsma & Molenaar, 2002). MHM is a psychometric property which justifies the practice of ranking respondents on a latent trait using his/her total score on a unidimensional scale. DMM, which is often termed as a hierarchical scale or a cumulative scale, ensures the invariance of ordering of all scale values for dichotomous and polytomous items (Sijtsma & Hemker, 1998; Sijtsma & Junker, 1996). In MSA, DMM is also termed as invariant item ordering (IIO), which, as a key feature of a cumulative scale, implies that the items in a scale can be ordered based on their difficulties or prevalence. This is popularly used in intelligence tests and in the medical context, where, for example, a scale assessing rehabilitation outcomes with IIO evaluates the level of recovery in terms of the difficulty of the functions re-acquired. As this research only wishes to assess the dimensionality of CZPD and whether it can validly order people on identified latent dimensions, DMM as a more restrictive assumption is not considered necessary, as items are not required to have distinctive difficulty levels (Sijtsma & van der Ark, 2017). The researcher has, therefore, opted to forego testing for IIO.

5.3.3 Mokken scale Analysis of MHM

Based on the discussion above, this study proposes to use an MSA procedure to investigate the MHM psychometric properties of CZPD in terms of its (1) *dimensionality*; (2) *monotonicity*; (3) *local independence*; and (4) *internal consistency*.

(1) *Dimensionality*: the assumption of unidimensionality implies that the items included in a scale are measuring the same latent attribute and that the items and the attribute share a positive and monotone relationship. Unidimensionality ensures that the total score of a scale reflects a single latent attribute. The property of unidimensionality pertains to a set of items that is subsequently referred to as a Mokken-scale. It is an empirical question which of the items under analysis fit the criteria of a Mokken-scale. Although this research hypothesises that the CZPD is uni-dimensional (as argued above), it cannot assume that this hypothesis is

acceptable in light of empirical testing. The empirical assessment of the entire set of 43 items is therefore conducted in terms of its dimensionality; which may lead to the conclusion of uni-dimensionality, but the researcher cannot exclude *a priori* that multiple dimensions will be identified.

(2) *Monotonicity*: the assumption of monotonicity assumes that a higher score on an item reflects (on average) a higher level of an individual on the (latent) attribute with which the item is associated. This can also be expressed as higher individual scores on the latent attribute leading to increasing probabilities of higher observed scores on the item in question.

(3) *Local independence*: based on unidimensionality and monotonicity, items driven by the same attribute will be positively correlated (where the term 'correlation' is used in a generic sense, rather than the often=-used Pearson correlation coefficient, which is, for reasons referred to earlier, inappropriate for ordered-categorical responses). The assumption of local independence implies that there are no other factors than the latent attribute that generate correlations between the items. In other words, if variance on that attribute is removed (by conditioning or controlling the attribute to be the same among a subgroup of participants for example), the items become independent, which means that their covariance disappears.

(4) *Internal consistency*: although this is not an MHM assumption, it is a fundamental psychometric property of a scale. In Mokken, the internal consistency of a scale is calculated as *rho*, a reliability measure of a heterogeneous monotonic scale proposed in Sijtsma and Molenaar (1987). The measure of *rho* is very close to Cronbach's alpha-- another measure of reliability also included in MSA (Sijtsma and Molenaar, 1987). In this study, as STATA v15 does not provide *rho*, Cronbach's alpha will be used as an adequate indicator of scale internal consistency.

For both dichotomous and polytomous items (Hemker, Sijtsma, Molenaar, & Junker, 1997; van der Ark, 2005), the fulfilment of the assumptions of MHM assures that the totals of the item-scores of respondents provide an ordered representation of respondents' latent attribute in question. In other words,

MHM does not yield a metric but an ordinal estimate of respondents' latent attribute scores (Hemker, Sijtsma, Molenaar, & Junker, 1997; Van der Ark & Bergsma, 2010). This psychometric property of a scale validates its factorial structure and serves as an critical base for further analysis of the relationship between the variables as well.

Based on the above discussion, the research present another research questions here:

Research question 2: Does the CZPD pilot questionnaire have a monotone hierarchical structure?

H2: the CZPD pilot questionnaire satisfies a monotone hierarchical model.

5.3.4 MSA Scale construction:

5.3.4.1 The coefficients of homogeneity:

To examine the MHM quality of a scale in MSA, the scalability coefficient of item *i* is denoted as H*i* (coefficient of homogeneity) which quantifies the association between the item *i* and the pool of remaining items under consideration. Based on the individual item's H*i* values of a scale, the scale's scalability coefficient of H quantifies the strength of the relationship between the total score of a scale and the underlying attribute driving it. H and H*i* range between 0 and 1 for positively correlated items (the coefficients can, in principle, attain negative values, but non-negligible negative values reflect that (an) item(s) is not scored in the same direction as other ones). Sijtsma & Molenaar (2002) indicate that for a scale to satisfy the assumption of unidimensionality and monotonicity, its scalability coefficient H and its constituent items scalability coefficient H*i* must be positive. Higher H*i* values indicate a stronger discrimination property of the item in separating the low from the high attribute total scores. A higher H, on the other hand, indicates that the total score of a person on a scale reflects his/her ordering on an attribute more accurately. Mokken (2011) suggests guidelines for the evaluation of these coefficients: H*i* <.30

(non-scale item); .40 > H*i* ≥ .30 (weak item); .50 > H*i* ≥ .40 (medium item); H*i* ≥ .50 (strong item). The same rule of thumb applies to the scale's scalability coefficient of H.

5.3.4.2 Unidimensionality and multidimensionality:

More often than not, in social science and behavioural science, one attribute could comprise two or more sub-attributes, which is termed as multiple dimensions. Moreover, there might also be unintended attributes that drive the responses and attenuate the influence of the intended latent attribute. When using MSA inductively, an automated item selection procedure (AISP) of MSA (Mokken, 2011; Sijtsma & Molenaar, 2002, chap. 5.) groups items into clusters of different attributes. AISP in MSA can be useful in distinguishing between different scales and picking out the "stray items" (Sijtsma & van der Ark, 2017). The AISP clusters items one by one based on a set of criteria. After selecting the two items with the highest coefficient of homogeneity, AISP then adds more items to the cluster on the basis of the H*i* value they would attain if included in the scale. If no further items can be added to the first cluster (given the criteria for inclusion), AISP continues to construct a second cluster (if possible at all), a third cluster etc., until no more item satisfies the inclusion criteria or until no more items are left. As introduced earlier, Mokken uses c=.3 as the default for the lower boundary that H*i* must satisfy to be included in a scale. However, Hemker, Sijtsma, and Molenaar (1995) and Sijtsma and Molenaar (2002, pp. 80-86) recommend that the analyst can choose different values (c=.00, .3, .4, .5 etc.) to investigate the dimensionality of a measure in an exploratory way to allow the emergence of different solutions. Emons et al. (2012) suggest that unidimensionality emerges when all or most items fall into one scale first and that as the c value increases, items start to be excluded and the scale becomes smaller. As the c value continues to increase, the scale keeps shrinking or breaks down into smaller scales or single non-scale items. Typical multiple dimension model is most apparent when after most or all items are included in one scale first, as the c value continues to increase, more scales form, which is the determining characteristics distinguishing single dimension model and multiple dimensional model.

5.3.4.3 MHM-- Data analytical procedures:

In the STATA v15 environment, to conduct MSA is conducted by assesses MHM in three steps:

(1) Dimensionality: an exploratory MSA assess a pool of items without a predetermined commitment to any dimensional structure. The result is based on inductive clustering. An alternative way of conducting MSA is confirmatory, when a predetermined dimensional structure is used as a hypothesis to be tested against the null-hypothesis that the items in question do not form a scale. In the STATA v15 environment, MSA is performed using the *msp* and the *loevh* module.
(2) Monotonicity: a significant H*i* exceeding the threshold value does not guarantee that an item shows a monotonically increasing item response function (IRF). Therefore, the *loevh* module in STATA v15 is used to test the monotonicity assumption, which is measured by a *Crit* value not exceeding 80.
(3) Scale properties: STATA v15 provides measures of Cronbach's alpha as an indicator of scale internal consistency.

5.4 Results

5.4.1 Step 1 dimensionality - exploratory MSA:

Table 5-1 demonstrates the AISP results for c=.0, .3, .4 and .5. When c is set at 0, out of the total of 43 items, 18 items cluster into scale 1, 8 items clustered into scale 2, the remaining items were unscalable. When c is set at .3, 16 items remain in scale 1, and the remainder of the scalable items scatters into five small clusters. When c is set at .4, more items leave scale 1, leaving 8 items in it and the remaining items were dispersed into seven very small scales. Scale 1 is still the biggest. When c is set at .5, scale one significantly reduces to a four-item scale and the remaining items form five additional small scales that consist of no more than three items each. Based on Emons et al., (2012) and Sijtsma & van der Ark (2017)'s H*i* =.30 rule of thumbs, the 43 item pool constructed for CZPD appears

that it contains a weak unidimensional scale (H=.38) with the 16 items' H*i* ranging between .32 and .45. The sixteen items include all six items developed to measure the aspect of Idea Interaction, four items for Decentralised Control, three items for Diversity, two items or Redundancy and one item describes Organised Randomness. See Table 5-2 for a detailed items list.

5.4.2 Step 2 monotonicity:

Based on the results from the dimensionality test, the 16-item scale was subjected to the monotonicity test using the *loevh* module in Stata v15. Illustrated in Table 5-2, each item was examined based on the Crit value. Molenaar and Sijtsma (2000, p. 74) suggested that when Crit < 40, sampling error is regarded as the primary contributor to minor violations of monotonicity. When 40 ≤ Crit < 80, the items show a mild violation of monotonicity and when Crit is larger than or equal to 80, monotonicity is severely violated. The results show that the 16 items forming scale one do not exceed Crit 40 and therefore the monotonicity assumption holds. Also, the Z values of the items and the scale are all lager than 1.65 (Molenaar & Sijtsma, 2000), suggesting that the H*i* and H value are significantly different from zero.

Items	Reverse Coded	*Mean*	*SD*	*C*=.0		*C*=.3						C=.4							C=.5					
				Cluster 1	Cluster 2	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
ii1	N	4.85	1.10	0.34		0.36						0.43												
ii2	N	5.02	1.11	0.36		0.38						0.46							0.56					
ii3	N	4.96	1.14	0.44		0.45						0.54							0.63					
ii4	N	4.37	1.41	0.34		0.36						0.47							0.63					
ii5	N	4.00	1.31	0.36		0.37						0.51							0.55					
ii6	N	4.38	1.29	0.38		0.40						0.47												
dc7	Y	5.54	1.17																					
dc8	Y	4.80	1.33																					
dc9	N	4.40	1.32																					
dc10	Y	4.32	1.54							0.49								0.46						
dc11	Y	2.46	1.30							0.49								0.46						
dc12	N	4.87	1.41																					
dc13	Y	3.97	1.73	0.33		0.34												0.44					0.51	
dc14	N	4.77	1.39	0.39		0.39						0.41											0.55	
dc15	N	5.07	1.38	0.44		0.45						0.44											0.56	
dc16	N	4.75	1.44																					
dc17	Y	4.03	1.52																					
dc18	N	5.03	1.39		0.34				0.38		0.41					0.41								
dc19	N	4.73	1.43																					
dc20	N	5.22	1.26	0.37		0.38							0.44											
dc21	Y	5.11	1.42																					
dc22	Y	5.35	1.36																					

dc23	N	3.94	1.60	0.28																				
dc24	N	5.34	1.12								0.33													
rd25	N	4.23	1.55																					
rd26	Y	3.78	1.52																					
rd27	Y	4.25	1.41																					
rd28	N	4.93	1.30																					
id29	N	5.69	1.12	0.37		0.39							0.52							0.63				
id30	N	5.89	0.98	0.33		0.35							0.49							0.55				
bd31	N	5.61	1.18	0.24	0.33			0.61							0.61							0.61		
bd32	N	5.56	1.16		0.26			0.61							0.61							0.61		
bd33	N	5.85	1.12	0.39		0.40							0.50							0.52				
r34	N	5.58	1.16		0.40				0.44		0.46					0.51								0.54
r35	N	5.06	1.35		0.40				0.45							0.45								0.52
r36	N	5.23	1.22		0.38				0.42							0.45								
r37	N	5.20	1.20	0.32	0.29	0.32			0.31								0.50							
r38	N	5.18	1.24	0.32		0.33											0.50							
r39	N	5.09	1.35		0.38				0.45		0.42					0.47								0.51
r40	N	5.19	1.33																					
or41	N	5.16	1.22				0.63							0.63								0.63		
or42	Y	3.78	1.54				0.63							0.63								0.63		
or43	N	5.49	1.26	0.35		0.38							0.47											
Scale H				0.35	0.35	0.38	0.63	0.61	0.41	0.49	0.41	0.46	0.48	0.63	0.61	0.45	0.50	0.45	0.59	0.57	0.63	0.61	0.54	0.52

Table 5- 1: Mean Item Scores, standard deviations, and Results of the Automated Item Selection Procedure (AISP) in Exploratory Mokken Scale Analysis.

Table 5- 2: Item Content, Mean Item Scores, Standard Deviations, and Results of the Automated Item Selection Procedure (AISP) in Mokken Scale Analysis of the 16 item CZPD scale

Individual Items (N=209)						
Items	**Labels**	**Reverse Coded**	**Mean**	**H_i**	**Z**	**Monotonous**
ii1	When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation).	N	4.85	0.36	18.38	Y
ii2	When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas.	N	5.02	0.38	19.61	Y
ii3	When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement.	N	4.96	0.45	23.05	Y
ii4	When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.	N	4.37	0.36	18.61	Y
Ii5	When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.	N	4.00	0.37	18.87	Y
Ii6	When discussing a specific problem, a resolution to the problem is reached by combining each other's ideas.	N	4.38	0.40	20.11	Y
dc13	There are only one or a few members of your team with the authority to decide on the way to carry out your project.	Y	4.03	0.34	17.20	Y
dc14	All team members collectively decide on the way to carry out this project.	N	4.77	0.39	19.99	Y
dc15	The end-product of your team project is the outcome of a collective decision-making process among team members.	N	5.07	0.45	23.10	Y
dc20	Members have the freedom to influence the end-product.	N	5.22	0.38	19.43	Y
id29	Members contribute ideas and/or suggestions voluntarily.	N	5.69	0.39	19.22	Y
id30	Individual contributions add to the diversity of ideas within the team.	N	5.89	0.35	17.59	Y
bd33	The end-product of the project is the outcome of a collective effort.	N	5.85	0.40	20.15	Y
r37	The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry specific language and terminologies, jargon	N	5.20	0.32	16.34	Y
r38	Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.)	N	5.18	0.33	17.05	Y
or43	We gained a sense of ownership of the end product. (end-product: the outcome of the team task)	N	5.49	0.38	18.92	Y
Scale						
H and Z				0.38	53.92	
Alpha	.89					

5.4.3 Step 3 internal consistency:

The scale has a Cronbach's alpha of .89, which suggests a high level of internal consistency between the items (Nunnally, 1975).

5.5 Discussion and further research

In this pilot study, forty-three seven-point Likert-items developed to measure the construct of CZPD were subjected to a Mokken Scale Analysis. In view of the ordered-categorical character of these items, MSA is a more suitable method than factor analysis for investigating the latent structure of the construct. Based on Item Response Theory, MSA is a method used to examine the dimensionality and scale properties of survey data, and it is especially suited to analyse ordered-categorical data. Although theoretically, the construct of CZPD and its constituent components is not entirely new and was developed based on the long-established theory of the zone of proximal development (Armstrong, 2008; Davis & Simmt, 2003; Goos, et al., 2002; Vygotsky, 1978), it is not certain whether CZPD is a single-dimensional or a multiple dimension construct. Therefore, it is of theoretical and practical importance to investigate the dimensionality of CZPD. Satisfying the assumption of MHM implies that users of this questionnaire can aggregate item-scores into a total score thus can rank the participants' responses on the latent trait of CZPD.

Overall, the results suggest that out of the forty-three items developed to measure CZPD, sixteen items were identified as fulfilling the assumption of MHM model and can be clustered into a single scale. Although the remaining twenty-seven items have formed into different clusters under different c value (see Table 5-1), the pattern is not consistent and some of the items are found to be clustered to more than one dimensions. Additionally, because the single dimension identified contains items representing all five aspects of CZPD, the small dimensions formed by the remaining twenty-seven items are either redundant or make no theoretical sense. In other words, collectively, these sixteen items are best regarded as constituting a unidimensional scale measuring the underlying team attribute of CZPD with the quality of monotonicity and a good level of internal consistency. This result agrees with the argument of David & Smmit (2000) that although CZPD taps into five different aspects of a team's self-organising

characteristics, these five aspects are closely related and somewhat interdependent on one other. This result also corroborates the findings in study 1, in which it was observed repeatedly that the CZPD elements are interdependent and interact to facilitate the emergence of CZPD. In other words, in CZPD, team collaboration and decision making process is characterised as an interaction between the five aspects. This preliminary result supports this argument and demonstrates that CZPD is a single dimensional scale which covers all of the five aspects of CZPD. Although there is no strong item (H*i* >.05) included and the scale falls into the weak category (H=.38), as a newly developed measurement tool, the scale is considered as having acceptable strength based on the H*i*=.30 lower bound threshold (Emons et al., 2012; Sijtsma & van der Ark, 2017). However, item fourteen (r37) (H*i* =.32) and fifteen (r38) (H*i* =.33) could be considered as having low scalability. This could mean that the items might be weak indicators of CZPD or that the wording of the items are poor.

Improving the wordings of the items is one way to improving item strength and developing stronger items (Emons et al., 2012). Item *r37* and *r38* (see Table 5-2) seem to be double-barrelled questions, which ask more than one thing at a time (Kumar, 2019). Specifically, in *r37*, the first half of the question asks whether members think they share the knowledge and skills, and the latter half asks whether this sharedness facilitates their communication. A similar problem can be found in item *r38* as well where the first half of the question asks if a team member thinks his/her teammates share practical knowledge and the second half asks if this sharedness makes collaboration easier. The problem with double-barrelled questions is that it introduces ambiguity into the response as participants ware effectively asked two questions but only allowed one response. Therefore, for the same question, one respondent might be responding to the first question, and the second respondent to the second question. The validity of this item is thus potentially compromised (Kumar, 2019). Notwithstanding wording problems, items fourteen and fifteen both fit MHM, demonstrating psychometric properties that satisfy the inclusion criteria. As there is no previous study to refer back to, it is proposed that both of these items are retained as part of scale for further analysis.

Some sampling issues might be considered as potential sources of bias for the factorial structure. First of all, the participants represent a very well-educated sample with over a half having a masters level education and nearly one quarter at the PhD level. This bias might have been introduced because the survey was first advertised on the website to a *Call for Participants* and the researcher's own social media page and, partly, because participants were encouraged to share the link of the survey to people they know. As both platforms are linked to both research and higher education sectors, the survey, therefore, had a better chance of reaching people with higher educational backgrounds. Moreover, as people tend to be connected to others of a similar social-economic background, the survey was more likely to be circulated among well-educated circles. Also, not all participants't team fits the definition of project teams, but as the aim of this polit study is to select items relevent to teamwork life in gerenral, the sample is considered sufficient. Another possible source of sampling error is that female participants were almost three times as many as male participants which might have resulted in a possible gender bias. Nevertheless, this study has captured a wide audience in terms of the participants' professional backgrounds and nationalities.

Another issue concerning the sample of this pilot study is that, although CZPD is inherently a collective construct, the analysis is conducted at the individual level. However, as this pilot study is only concerned with the dimensionality of CZPD and the scalability of the newly developed items, the participants were not required to take part along with their current or past teammates and the data remains at the individual level.

Notwithstanding the drawbacks, this pilot study has provided valuable information for future research. The next phase of the research is aimed at testing the PBrTF model by including CZPD into the picture. Taking into account the data level issues, the next study aims to collect data from project teams and analyse data at the team level. The design and data analysis procedure are detailed in the next chapter.

5.6 Chapter summary

In this chapter, the 43 item pool of CZPD was subjected to MSA to test its dimensionality. The result suggests that CZPD is a 16 item unidimensional scale. The next study will test the cross-time dimensional invariance of all the four scales used for testing the PBrTF model.

It is worth reiterating that, the choice of MSA over factor analysis is based on a close and careful examination of the underlining assumption of both techniques, not a personal preference of the researcher. In other words, the nature of the data disqualifies it for factor analysis. As is discussed, Likert-scale scored data is not metric, which violates the fundamental assumption of all factor analysis techniques, including, for example, EFA or CFA. As a result, using factor analysis on non-metric data (in the case of the data in this project) will yield a type I error, which commonly manifests itself as "overdimentionalisation". In plain English, it means seeing things that are not actually there. Such a statistical artefact has a profound negative impact on the subsequent analysis that uses it as building blocks. The potential societal and economic implication of policies made based on such ill-informed results is impossible to estimate. A type I error occurs when a scientist analyses a dataset without giving due consideration to the fundamental assumption of the chosen technique; for example, using a t-test on data that shows apparent heterogeneity of variance and/or the residuals are obviously not normally distributed. The result of such an analysis is not to be trusted. In this case, an analyst will choose to use the nonparametric counterpart of the T-test, the Mann-Whitney U test, instead. The same analogy applies in here too. "Overdimentionalisation", like "underdimentionalisation", is a term used to describe a scientific observation, a phenomenon that happens to be discovered as a result of rigorous research. It is the same as stating that there are trees in a forest.

Moreover, it is not accurate to consider MSA as a technique specialised in shoehorning unidimensional scales. In fact, unidimentionality is the underlying assumption for every dimension found in CFA or EFA as well. It is based on this assumption it is possible to use an aggregated score in a scale to represent a participants amount of the latent trait of interest. Without unidimentionality, it is not possible to know what the scale score represents and also not possible to order participants on a latent trait. Used to explore the dimensionality of a scale, MSA functions the same way as EFA or CFA. As is illustrated in Table 5-1, with different

c value, the AISP in MSA has spat out three distinct compositions, including two dimensions, six dimensions and seven dimensions. However, after examination, only one single scale or dimension was interpretable based on the CZPD theory. It is this finding, not the researcher's preference, that led to the decision of using this single dimensional scale for CZPD. However, as CFA is conventionally preferred, a CFA result is presented in Appendix E.

CHAPTER VI: STUDY 3 DIMENSIONALITY AND DIMENSIONAL STABILITY OF THE MEASURES

6 Overview

In the preceding chapter, the research assessed the dimensionality of the CZPD questionnaire using Mokken Scale Analysis. The resulting scale included sixteen items from the item pool and demonstrated that from an Item Response Theory perspective, CZPD can be considered as a unidimensional construct and the 16-item scale satisfies the Monotone Hierarchical Model (MHM, see section 5.2 for details). Based on this result, I have collected longitudinal data to test the hypothesised theoretical relationships between team efficacy, CZPD, team flow antecedents and team flow core experiences. Before going into the hypotheses testing, this chapter conducts a dimensional stability test on all the measures used. To achieve this, the researcher has conducted MSA analysis using four types of data matrices to test for interindividual differences, intraindividual differences and intraindividual changes.

6.1 Testing measurement invariance

6.1.1 Study overview

In this study, the researcher tests the invariance of the measures by examining the three sources of individual differences present in the current dataset. As a longitudinal design with two waves of data collection, the variance in the data can be seen as deriving from the following variance components: inter-individual differences, intra-individual differences and intra-individual changes, and random noises. Therefore, the four measures, team efficacy, CZPD, team flow antecedents and team flow are subjected to an analysis to determine their suitability in longitudinal causal inference analyses. Using Mokken Scale Analysis, the researcher configures the data to a long-form (stacked data) and wide-form to examine the influences of three types of differences on the stability of the

measurements over time. Also, the four measures are examined for their monotonic hierarchical structure.

6.1.2 Study design

In study 2, the researcher explored the dimensionality of the CZPD questionnaire and demonstrated its unidimensional structure. The targeted sample in this study were university student project teams assembled to carry out assignments that count towards the fulfilment of their degree. To identify the students who needed to conduct teamwork, the researcher searched the university course catalogue. An email of invitation to participate was sent to all module convenors detailing the purpose and procedure of the study. About a third of the module convenors granted access to their students and helped distribute the information sheet to their students for them to consider if they would like to participate. The researcher took the paper-and-pencil-based questionnaires to the lectures of potential participants. As the hypothesised model theorises a reciprocal relationship between the constructs, a longitudinal design was devised to collect data at two time-points during their team project. The survey was distributed to the same participants twice: Once at the beginning (T1) and once at the finishing point (T2) of their team project.

In the participant information sheet (which has been reviewed and approved by the medical school ethics committee), it is clearly stated that the participation was voluntary and non-identifiable. The researcher had repeated this to the participants while being introduced to them at the end of a class session and students were free to leave after that introduction. The lecturers who served as a gatekeeper were also informed of this matter and they were asked to emphasised this to their students as well. In fact most students left the classroom immediately after the classes were finished, the participants who wished to take part were the ones voluntarily remained after their lectures to speak to me. This is the reason why the data collection took almost 6 months. I started communicating with the module convenors before Charismas 2018, the data collection did not complete until mid-May 2019.

6.1.3 Sample, procedure and measures

6.1.3.1 Participants:

In total, 1209 responses were collected, consisting 529 participants at T1 and 680 at T2. At Time 1, 50.7% (N=268) were male, 48% (N=254) female and 1.2% (N=6) missing. 56% (N=296) were British, 28.5.% (N=151) Asian, 8.1% (43) European, 3% (N=16) African, 1.7% (N=9) American, 0.2% (N=1) Australian. 2.5% (N=13) failed to report nationality. 64% were undergraduates with 12.1% (N=64) in year one, 19.1% (N=101) in year two and 32.1% (N=107) in year three, and 35.3% (N=187) were postgraduates. At Time 2, 52.9% (N=360) were male, 44.6% (N=303) female and 2.5% (N=17) reported their sex as other. 51.6% (N=351) were British, 33.5.% (N=228) Asian, 7.2% (N=49) European, 3.8% (N=26) African, 1.6% (N=11) American. 2.1% (N=14) did not report their nationality. 56.5% (N=384) were undergraduates with 8.8% (N=60) in year one, 9.1% (N=62) in year two and 38.5% (N=262) in year three, 43.5% (N=296) are postgraduates. The teamwork assignments accounted for different percentages of the overall grade of the module, ranging between 20% to 100%, with an average of 60.96%. The modules are given a 10 to 40 credit, averaging at 19.84 credit. The group size ranged from 2 to 9 members, averaging at 4.90 (SD=1.15). The student teams were from different disciplines, at T1, 11.2% (N=59) were Mathematics students, 35.2% (N=186) were studying Business and Economics, 2.8% (N=15) were studying Computer Science, 23.4% (N=124) were Engineers, 5.7% (N=30) were Architects, 11% (58) were studying the Political Science, 5.7% (N=30) studied Food Science, 5.1% (N=27) were Medical students. At T2, 6.6% (N=45) were Mathematics students, 58.2% (N=396) were studying Business and Economics, 2.6% (N=18) were studying Computer Science, 19.4% (N=132) were Engineers, 4.3% (N=29) were Architects, 6.2% (42) were studying the Political Science, 2.6% (N=18) studied Food Science.

The participants were assessed at about one week into their team project and again at about one week before they finished their project, regardless of the duration of different projects. The data was collected in this way to ensure that the participants were assessed at similar points in time in relation to the start and finish of their respective projects.

6.1.3.2. Measures:

6.1.3.2.1. CZPD

The researcher used the sixteen-item CZPD questionnaire developed and piloted in Chapter IV. The results suggest that CZPD is a single-dimensional scale containing items describing a self-organising peer learning social system characterised by idea interaction, decentralised control, diversity of skills and background, redundancy of team knowledge and organised randomness. CZPD is measured on a Likert-scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). An example item of this is "When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas." See table 6-1 for details.

Table 6- 1: CZPD scale (16-item version) used in Mokken Scaling Analysis.

Label	Full question text	Response categories
ii1	When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation).	1 (Never) to 7 (Always)
ii2	When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas.	1 (Never) to 7 (Always)
ii3	When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement.	1 (Never) to 7 (Always)
ii4	When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.	1 (Never) to 7 (Always)
ii5	When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.	1 (Never) to 7 (Always)
ii6	When discussing a specific problem, a resolution to the problem is reached by combining each other's ideas.	1 (Never) to 7 (Always)
dc13	There are only one or a few members of your team with the authority to decide on the way to carry out your project.	1 (Strongly Disagree) to 7 (Strongly Agree)
dc14	All team members collectively decide on the way to carry out this project.	1 (Strongly Disagree) to 7 (Strongly Agree)
dc15	The end-product of your team project is the outcome of a collective decision-making process among team members.	1 (Strongly Disagree) to 7 (Strongly Agree)
dc20	Members have the freedom to influence the end-product.	1 (Strongly Disagree) to 7 (Strongly Agree)
id29	Members contribute ideas and/or suggestions voluntarily.	1 (Strongly Disagree) to 7 (Strongly Agree)

id30	Individual contributions add to the diversity of ideas within the team.	1 (Strongly Disagree) to 7 (Strongly Agree)
bd33	The end-product of the project is the outcome of a collective effort.	1 (Strongly Disagree) to 7 (Strongly Agree)
r37	The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry specific language and terminologies, jargon	1 (Strongly Disagree) to 7 (Strongly Agree)
r38	Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.)	1 (Strongly Disagree) to 7 (Strongly Agree)
or43	We gained a sense of ownership of the end product. (end-product: the outcome of the team task)	1 (Strongly Disagree) to 7 (Strongly Agree)

6.1.3.2.2. Perceived collective efficacy (PCES):

To measure team efficacy, the researcher used the Perceived Collective Efficacy Scale (PCES) (Salanova et al., 2003), adapted from the Generalised Self-Efficacy assessment originally developed by Schwarzer (1999). Salanova et al. (2003) adjusted the wordings for use by workgroups, shifting the referent from "*I*" to "*We*". PCES consists of four items which are measured on a Likert-scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). An example item is "My team is able to solve difficult tasks if we invest the necessary effort." See table 6-2 for details.

Table 6- 2: Perceived collective efficacy scale (CE) used in Mokken Scale Analysis. Adapted from Salanova, M., Llorens, S., Cifre, E., Mart´ınez, I. M., & Schaufeli, W. B. (2003).

Label	Full question text	Response categories
PCES _1	I feel confident about the capability of my team to perform the tasks very well.	1 (Strongly Disagree) to 7 (Strongly Agree)
PCES _2	My team is able to solve difficult tasks if we invest the necessary effort.	1 (Strongly Disagree) to 7 (Strongly Agree)
PCES _3	I feel confident that my group will be able to manage effectively unexpected troubles.	1 (Strongly Disagree) to 7 (Strongly Agree)
PCES _4	My group is totally competent to solve the task.	1 (Strongly Disagree) to 7 (Strongly Agree)

6.1.3.2.3. Team flow antecedents (TFa):

To measure the three antecedents of team flow, namely the Challenge-Skill Balance, Goal Clarity and Feedback Clarity (see discussion in Chapter II), the researcher used twelve items from Quinn (2005), which is an adapted version of the Flow State Scale (FSS), developed by Jackson & Marsh (1996) for sports participants. Each dimension in the adapted FSS contains four items. The researcher chose to use the Quinn (2005) version because although the original FSS is popularly used, it is not suitable for the workplace environment as it is designed to assess flow experience in athletes, (Jackson & Marsh, 1996). Therefore, while studying the flow experience among knowledge workers, Quinn (2005) adapted the wording of FSS based on interviews with engineers, scientists, managers and technicians to meet the specific working conditions of knowledge workers. As the participants of the current study relate more to knowledge workers than to athletes, the researcher has therefore chosen to use the Quinn (2005) version. On top of these changes in the wording, the referent "I" was changed to "we" for use in teams. For example, instead of stating "I felt I was competent enough to meet the high demands of the situation." it states "we felt we were competent enough to meet the high demands of the situation." The team flow antecedents scale (TFa) consists of twelve items measured on a Likert-scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). See table 6-3 for the detailed items.

Table 6- 3: Perceived team flow antecedents scale (TFa) used in Mokken Scale Analysis. Adapted from Quinn (2005) and Tenenbaum, Fogarty, & Jackson, (1999).

Label	Full question text	Response categories
TFa_1	We were challenged, but we believed our skills would allow us to meet the challenge.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_2	Our ability matched the high challenge of the situation.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_3	We felt we were competent enough to meet the high demands of the situation.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_4	The challenge and our skills were at an equally high level.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_5	We knew clearly what we wanted to do.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_6	We had a strong sense of what we wanted to do.	1 (Strongly Disagree) to 7 (Strongly Agree)

TFa_7	We knew what we wanted to achieve.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_8	Our goal was clearly defined.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_9	It was really clear to us that we were doing well.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_10	We were aware of how well we were performing.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_11	We had a good idea about how we were doing while we were performing.	1 (Strongly Disagree) to 7 (Strongly Agree)
TFa_12	We could tell by the way we were performing how well we were doing.	1 (Strongly Disagree) to 7 (Strongly Agree)

6.1.3.2.4 Team Flow core (TFc):

The core of the team flow experience was measured using the Work-reLated Flow inventory (WOLF) developed by Bakker (2008). Unlike the Flow State Scale (FSS; Tenenbaum et al., 1999) which measures all nine dimensions of the flow experience including its prerequisites and core characteristics in a sports person, WOLF was designed to measure the core of workplace flow, a short-term peak experience of absorption, work enjoyment and intrinsic work motivation (Bakker, 2008). In order to measure team flow experience in project teams, the referent "I" was also changed to" we". For example, the original item "When I am working, I think about nothing else." was adapted to "When we are working, we think about nothing else." This questionnaire was thus labelled as T_WOLF. For a full list of the items, see table 6-4 for details. T_WOLF contains thirteen items measured on a Likert-scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

Table 6- 4: Perceived team flow core experience scale (TFc) used in Mokken Scale Analysis. Adapted from (Bakker, 2005).

Label	Full question text	Response categories
T_WOLF_1	When my team is working on the project, we think about nothing else.	1 (Strongly Disagree) to 7 (Strongly Agree)

T_WOLF _2	We get carried away by our work.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF _3	When my team is working on the project, we forget everything else around us.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_4	We are totally immersed in our work.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_5	Our work gives us a good feeling.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_6	We do our work with a lot of enjoyment.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_7	We feel happy during our work.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_8	We feel cheerful when we are working.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_9	We would still do this work even if it's not assessed.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_10	We found that we also want to work on this project in our free time.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_11	We work because we enjoy it.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_12	When we are working on the project, we are doing it for ourselves.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_13	We get our motivation from the work itself, and not from the reward of it.	1 (Strongly Disagree) to 7 (Strongly Agree)

6.1.4 Ethical considerations

The study follows the British Psychological Society ethical guidelines (BPS code of Ethics and Conduct, applicable form 2009) and received ethical approval from the Medicine & Health Sciences Research Ethics Committee from the University of Nottingham (Ethics Reference No; LT08022016 SoM PAP). Participation on both occasions was entirely voluntary, and potential participants were only contacted after access was granted by their tutor or course convenor. Before the distribution of the survey on both occasions, potential participants were

briefed about the purpose and procedure of the study and were given an information sheet with the details of the study and the contact details of the researcher and the ethics committee should they wish to require more information or lodge a complaint. The contact details of the university counselling service were also provided in the event participants felt the need for support as a result of taking part in the study. Participants were made aware that their participation is entirely voluntary and that they are free to withdraw at any time before and during the data collection, but that they would not be able to withdraw after the raw data is destroyed as their responses would no longer be identifiable. Participants were given the contact details of the researcher in their Participant Information Sheet and in the Consent Form so they can contact the researcher in case they would like to withdraw their response within 6 months of data collection. To withdraw their responses, participants will need to provide the researcher with their identifying information for their data to be deleted. Participants were also required to sign the consent form before completing the survey and were asked to confirm awareness of their rights to freely take part or withdraw from the study.

To match the longitudinal responses of the survey, the researcher asked the participants to give their date of birth as a unique identifier in combination with their tutor/course convenor's initials. Participants were provided with a full explanation of why participants are requested to provide such information before taking part and were assured that their responses will be treated with strict confidentiality and that their data will be used only for research purposes. Moreover, participants were informed that their responses would not be made identifiable in any other way.

6.2 Research questions

In order to investigate the proposed causal relationships between the variables, a longitudinal design was deemed to be advantageous in testing the PBrTF model (see Figure 2-3). A causal relationship ascribes variance in one variable, i.e. the result, to differences or changes in another, i.e., the cause. In a longitudinal design, such a hypothesised relationship can be more confidently supported if the results show that the variance observed in the proposed *cause*

variables at one point in time is related to the variance of the proposed *result* variables observed at a later occasion. Statistically, such a causal relationship is tested using a panel model (Acock, 2013; Preacher, 2015). A panel model illustrates that the variance of the proposed *cause* variable at time 1 affects not only the variances of the proposed *result* variable at time 2 but also the variance of the proposed *cause* variable at time 2. Explained in Preacher (2015), longitudinal data analysts term this relationship between the same variable at both time 1 and 2 as *autoregressive effects* and by including this relationship in the design, the analysis takes into account the individual differences in the same variable across the time lag (intra-individual changes). In other words, in a panel design, by partialling out this source of variance, the resulting parameters more accurately reflect the true relationship between the cause and the effect (Acock, 2013).

However, in a longitudinal design where data are collected at multiple time points, variables may change over time in terms of their values, as well as in their meaning or interconnections. To illustrate this, Buss (1974) presented a general developmental model discussing the potential differences and changes that could be introduced by various sampling strategies or comparing strategies. According to Buss (1974), by sampling across the three dimensions of *individuals*, *variables* (items) and *occasions*, differences can be summarised as *interindividual differences*, *intraindividual differences* and *intraindividual changes*. Based on Cattell's (1946, 1952) three dimensional data framework, Buss (1974, p71) defines interindividual differences as "*sampling across individuals for each variable at one occasion*", intraindividual differences as "*sampling across variables for each individual at one occasion*" and intraindividual changes as "*sampling across occasions for each variable for one individual*". According to this framework, the data collected for this study is characterised as a three-dimensional data matrix: Individual x Variable x Occasion, which implies that any differences or changes of items and scales can be potentially identified from these three perspectives.

As discussed above, in a panel design, if the assumption that intra-individual changes are stable does not hold, a straightforward comparison of values from T1 to T2 is not valid. Therefore, the main research questions and hypotheses of this study are:

R1: *Does the team efficacy questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

Hypothesis (H1): the team efficacy questionnaire demonstrates cross-lagged monotonic hierarchical dimensionality from T1 to T2.

R2: *Does the CZPD questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

Hypothesis (H2): the CZPD questionnaire demonstrates cross-lagged monotonic hierarchical dimensionality from T1 to T2.

R3: *Does the team flow antecedents questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

Hypothesis (H3): the team flow antecedents questionnaire demonstrates cross-lagged monotonic hierarchical dimensionality from T1 to T2.

R4: *Does the team flow questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

Hypothesis (H4): the team flow antecedents questionnaire demonstrates cross-lagged monotonic hierarchical dimensionality from T1 to T2.

6.2.1 Method—the data analytical design

To examine the dimensionality and detect potential dimensional instabilities in all measures, this study uses a Mokken Scale Analysis (MSA) on all constructs using four types of data matrices. The analysis was conducted in three stages.

(1) Following the same analytical procedures described in the pilot study (Study 2), MSA was first conducted separately on the data collected at T1 (data matrix A) and T2 (data matrix B). This approach compares two data sets in terms of interindividual differences and intraindividual differences side by side. The results present the scales' dimensionality, monotonicity and internal consistency for each occasion. Also, by comparison, the results could show whether the measurement tools used would demonstrate similar scalabilities across the time lag as preliminary screening for potential developmental changes.

(2) In the next stage, two questions were addressed: (1) whether attrition of cases from T1 to T2 leads to biases in the T2 data compared to the T1 data; and (2) whether developments and experiences between T1 and T2 change the meaning of the items. In order to answer these questions, the researcher reconfigured the data matrix using a "stacking" approach. As demonstrated in Table 6-5 to 6-8, the "stacking" approach increases the number of participants, or cases, by giving each participant the additional characteristic of time, labelling each case as *case x time point*. After relabelling, the cases consist of three groups: (a) participants that took part in both occasions, (b) participants that only took part at time 1, and (c) participants that only took part at time 2. Comparing scale analyses performed on these groups allows testing the extent that attrition changes the inter-relations between the items (as expressed in their scalability). Using this "stacked" data matrix (data matrix C), the MSA could detect the potential *interindividual differences* in terms of scale dimensionality and monotonicity. This could be detected if the results showed that items belonging to the same dimension were clustered on different dimensions or shown as non-scalable items.

(3) In the last stage, the researcher combined the two data sets collected from time 1 and time 2, doubling the number of items by giving all items the additional characteristic of time: *item x time point*. See Table 6-5 to 6-8 for an illustration. This new "joint" data set (data matrix D) represents the intraindividual changes in intraindividual differences. By

registering items with their time characteristics, the results of MSA demonstrate whether the potential changes in people's perceptions and responses as a result of the time lag are influential enough to hinder the items from reflecting the same underlying dimension. In other words, intraindividual changes could be detected if the item becomes nonscalable or that it is clustered on a different scale than it was in a single time dataset. This stage in the analysis examines the homogeneity of the scales in terms of their unidimensionality and monotonicity across time.

In summary, by "folding" the *occasion* dimension into the *variable* and the *individual* dimension, both the "stacking" and "joint" approach collapse the original three-dimensional data matrix into a two dimensional one, whilst preserving the information provided by the time lag. By using the stacked (long-form) and joint data (wide-form), investigations of dimensional stabilities can be conducted with analytical techniques such as MSA.

Table 6- 5: MSA results of perceived collective efficacy scale (CE) in four types of data matrices.

Items	Reverse Coded	Data matrix A (N=529, t1 only)				Data matrix B (N=681, t2 only)				Data matrix C (N=1209, stacking)				Data matrix D (N=278, joint)				
		Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Items	Mean	H_i	Z	Monotonous
Cefficacy_1	N	5.11	0.80	30.57	Y	5.38	0.80	35.08	Y	5.26	0.81	47.23	Y	T1_Cefficacy_1	5.32	0.63	26.48	Y
Cefficacy_2	N	5.39	0.82	31.63	Y	5.58	0.81	35.32	Y	5.49	0.82	47.44	Y	T1_Cefficacy_2	5.58	0 .61	25.87	Y
Cefficacy_3	N	5.28	0.82	31.22	Y	5.41	0.82	35.74	Y	5.35	0.82	48.00	Y	T1_Cefficacy_3	5.47	0.63	26.95	Y
Cefficacy_4	N	5.38	0.81	31.05	Y	5.55	0.82	36.03	Y	5.48	0.80	46.62	Y	T1_Cefficacy_4	5.60	0.58	24.47	Y
														T2_Cefficacy_1	5.38	0.63	26.91	Y
														T2_Cefficacy_2	5.59	0.63	26.85	Y
														T2_Cefficacy_3	5.41	0.62	26.14	Y
														T2_Cefficacy_4	5.58	0.61	25.85	Y
		Scale				Scale				Scale				Scale				
H and Z			0.81	44.00			0.81	50.25			0.81	66.91				0.62	52.37	
Alpha		0.93				0.94				0.94					0.92			

Table 6- 6: MSA results of perceived team flow core experience scale (TFc) in four types of data matrices. (ns=nonsalable; na=not available).

Items	Reverse Coded	Data matrix A (N=529, t1 only)				Data matrix B (N=681, t2 only)				Data matrix C (N=1209, stacking)				Data matrix D (N=278, joint)				
		Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Items	Mean	H_i	Z	Monotonous
TeamFlow_Core_1	N	3.63	0.32	24.26	Y	3.92	0.37	32.33	Y	3.79	0.36	41.38	Y	T1_TeamFlow_Core_1	ns	na	na	na
TeamFlow_Core_2	N	3.66	0.44	33.14	Y	4.02	0.43	37.43	Y	3.86	0.45	51.17	Y	T1_TeamFlow_Core_2	3.73	0.39	29.53	Y
TeamFlow_Core_3	N	3.16	0.45	33.85	Y	3.60	0.47	40.41	Y	3.41	0.47	54.04	Y	T1_TeamFlow_Core_3	3.18	0.38	28.39	Y
TeamFlow_Core_4	N	3.65	0.47	35.56	Y	4.11	0.52	45.25	Y	3.91	0.51	58.93	Y	T1_TeamFlow_Core_4	3.67	0.43	32.60	Y
TeamFlow_Core_5	N	4.27	0.54	40.43	Y	4.74	0.54	46.60	Y	4.54	0.55	62.88	Y	T1_TeamFlow_Core_5	4.35	0.49	36.50	Y
TeamFlow_Core_6	N	4.18	0.58	43.76	Y	4.60	0.56	48.83	Y	4.42	0.58	66.57	Y	T1_TeamFlow_Core_6	4.30	0.53	40.46	Y
TeamFlow_Core_7	N	4.23	0.55	42.01	Y	4.62	0.55	47.73	Y	4.45	0.56	64.58	Y	T1_TeamFlow_Core_7	4.31	0.53	39.81	Y
TeamFlow_Core_8	N	4.29	0.53	40.24	Y	4.64	0.54	46.73	Y	4.49	0.54	62.66	Y	T1_TeamFlow_Core_8	4.39	0.47	35.66	Y
TeamFlow_Core_9	N	2.75	0.50	36.82	Y	3.25	0.51	43.35	Y	3.03	0.51	58.07	Y	T1_TeamFlow_Core_9	2.78	0.50	36.71	Y
TeamFlow_Core_10	N	3.32	0.49	36.99	Y	3.70	0.52	45.23	Y	3.53	0.52	59.42	Y	T1_TeamFlow_Core_10	3.36	0.46	35.10	Y
TeamFlow_Core_11	N	3.33	0.56	43.04	Y	3.80	0.57	49.06	Y	3.60	0.57	66.35	Y	T1_TeamFlow_Core_11	3.36	0.52	39.90	Y
TeamFlow_Core_12	N	3.95	0.38	28.43	Y	4.40	0.41	35.08	Y	4.20	0.41	46.57	Y	T1_TeamFlow_Core_12	ns	na	na	na
TeamFlow_Core_13	N	3.40	0.52	39.51	Y	4.05	0.53	46.19	Y	3.77	0.54	62.23	Y	T1_TeamFlow_Core_13	3.45	0.50	38.06	Y
														T2_TeamFlow_Core_1	3.95	0.35	26.63	Y
														T2_TeamFlow_Core_2	4.18	0.46	34.99	Y
														T2_TeamFlow_Core_3	3.54	0.47	36.20	Y
														T2_TeamFlow_Core_4	4.02	0.52	39.17	Y
														T2_TeamFlow_Core_5	4.53	0.51	38.70	Y
														T2_TeamFlow_Core_6	4.33	0.51	39.19	Y

													T2_TeamFlow_Core_7	4.36	0.52	39.64	Y
													T2_TeamFlow_Core_8	4.51	0.50	38.14	Y
													T2_TeamFlow_Core_9	2.89	0.53	38.80	Y
													T2_TeamFlow_Core_10	3.47	0.50	37.84	Y
													T2_TeamFlow_Core_11	3.50	0.53	40.41	Y
													T2_TeamFlow_Core_12	4.22	0.39	29.32	Y
													T2_TeamFlow_Core_13	3.68	0.49	37.69	Y
		Scale				Scale				Scale					Scale		
H and Z			0.49	93.51			0.50	110.37			0.50	147.69			0.48	125.40	
Alpha		0.92				0.92				0.92				0.95			

Table 6- 7: MSA results of perceived team flow antecedents scale (TFa) in four types of data matrices.

Items	Reverse Coded	Data matrix A (N=529, t1 only)				Data matrix B (N=681, t2 only)				Data matrix C (N=1209, stacking)				Data matrix D (N=278, joint)				
		Mean	Hi	Z	Monotonous	Mean	Hi	Z	Monotonous	Mean	Hi	Z	Monotonous	Items	Mean	Hi	Z	Monotonous
TFa_1	N	4.96	0.32	24.26	Y	5.37	0.55	45.13	Y	5.19	0.53	58.60	Y	T1_TFa_1	5.13	0.41	30.84	Y
TFa_2	N	4.84	0.59	42.60	Y	5.33	0.59	48.70	Y	5.12	0.60	66.28	Y	T1_TFa_2	4.97	0.47	35.00	Y
TFa_3	N	5.03	0.56	39.99	Y	5.40	0.57	47.19	Y	5.24	0.58	63.26	Y	T1_TFa_3	5.14	0.45	33.93	Y
TFa_4	N	4.78	0.54	39.34	Y	5.22	0.54	44.50	Y	5.03	0.56	61.09	Y	T1_TFa_4	4.87	0.43	32.00	Y
TFa_5	N	4.76	0.57	41.33	Y	5.34	0.58	48.26	Y	5.09	0.59	65.35	Y	T1_TFa_5	4.86	0.49	36.83	Y
TFa_6	N	4.84	0.57	41.35	Y	5.36	0.61	50.27	Y	5.13	0.61	66.69	Y	T1_TFa_6	4.94	0.48	36.15	Y
TFa_7	N	5.22	0.56	39.79	Y	5.64	0.59	47.80	Y	5.46	0.59	63.72	Y	T1_TFa_7	5.33	0.44	33.00	Y
TFa_8	N	5.23	0.51	36.26	Y	5.56	0.53	43.44	Y	5.42	0.53	57.77	Y	T1_TFa_8	5.33	0.45	33.69	Y
TFa_9	N	4.42	0.58	41.85	Y	4.90	0.59	48.35	Y	4.69	0.59	65.44	Y	T1_TFa_9	4.58	0.44	33.52	Y
TFa_10	N	4.36	0.53	38.38	Y	4.89	0.57	46.87	Y	4.66	0.57	62.32	Y	T1_TFa_10	4.54	0.40	30.52	Y
TFa_11	N	4.45	0.48	34.97	Y	5.03	0.58	47.85	Y	4.78	0.60	65.78	Y	T1_TFa_11	4.57	0.46	34.50	Y
TFa_12	N	4.54	0.56	40.19	Y	5.08	0.58	47.61	Y	4.84	0.58	64.08	Y	T1_TFa_12	4.63	0.43	32.57	Y
														T2_TFa_1	5.38	0.45	34.28	Y
														T2_TFa_2	5.38	0.45	34.10	Y
														T2_TFa_3	5.44	0.46	34.55	Y
														T2_TFa_4	5.17	0.43	32.16	Y
														T2_TFa_5	5.23	0.53	40.06	Y
														T2_TFa_6	5.29	0.53	39.82	Y
														T2_TFa_7	5.56	0.48	36.08	Y
														T2_TFa_8	5.44	0.44	32.94	Y
														T2_TFa_9	4.80	0.51	38.52	Y

														T2_TFa_10	4.76	0.45	34.06	Y
														T2_TFa_11	4.81	0.47	35.76	Y
														T2_TFa_12	4.96	0.49	37.32	Y
		Scale				Scale				Scale					Scale			
H and Z			0.55	97.61			0.57	115.36			0.50	147.69				0.46	119.98	
Alpha		0.93				0.93				0.92					0.95			

Table 6- 8: MSA results of CZPD scale (16-item version) in four types of data matrices. (ns=nonsalable; na=not available).

Items	Reverse Coded	Data matrix A (N=529, t1 only)				Data matrix B (N=681, t2 only)				Data matrix C (N=1209, stacking)				Data matrix D (N=278, joint)				
		Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Mean	H_i	Z	Monotonous	Items	Mean	H_i	Z	Monotonous
ii1	N	5.12	0.44	35.92	Y	5.29	0.53	49.27	Y	5.21	0.50	61.13	Y	T1_ii1	ns	na	na	na
ii2	N	5.17	0.50	40.55	Y	5.36	0.55	50.68	Y	5.28	0.53	65.12	Y	T1_ii2	5.26	0.40	31.21	Y
ii3	N	5.22	0.51	41.50	Y	5.42	0.54	50.25	Y	5.33	0.53	65.47	Y	T1_ii3	5.29	0.39	30.43	Y
ii4	N	4.81	0.50	39.66	Y	5.12	0.52	47.99	Y	4.99	0.51	62.60	Y	T1_ii4	4.91	0.35	27.89	Y
ii5	N	4.40	0.44	35.31	Y	4.78	0.46	41.79	Y	4.61	0.46	55.10	Y	T1_ii5	4.49	0.32	24.88	Y
ii6	N	4.84	0.44	35.63	Y	5.08	0.48	44.12	Y	4.97	0.47	56.96	Y	T1_ii6	ns	ns	ns	na
dc13	Y	ns	na	na	na	ns	na	na	na	ns	na	na	na	T1_dc13	ns	na	na	na
dc14	N	5.17	0.45	36.80	Y	5.17	0.47	43.17	Y	5.17	0.46	56.58	Y	T1_dc14	5.26	0.37	29.66	Y
dc15	N	5.36	0.51	40.83	Y	5.51	0.50	45.84	Y	5.44	0.50	61.57	Y	T1_dc15	5.52	0.40	32.00	Y
dc20	N	5.65	0.40	32.05	Y	5.64	0.37	33.76	Y	5.64	0.38	46.30	Y	T1_dc20	5.74	0.34	26.88	Y
id29	N	5.68	0.47	37.24	Y	5.70	0.50	45.13	Y	5.69	0.49	58.43	Y	T1_id29	5.78	0.40	30.42	Y
id30	N	5.65	0.45	35.58	Y	5.64	0.46	42.26	Y	5.64	0.45	55.05	Y	T1_id30	5.75	0.32	24.89	Y
bd33	N	5.81	0.47	36.92	Y	5.86	0.50	45.26	Y	5.84	0.49	58.40	Y	T1_bd33	5.92	0.38	29.69	Y
r37	N	5.00	0.40	32.54	40	5.28	0.36	32.90	Y	5.16	0.38	46.74	Y	T1_r37	5.10	0.31	24.43	Y
r38	N	4.40	0.44	35.31	Y	5.39	0.43	39.55	Y	5.32	0.44	53.19	Y	T1_r38	5.35	0.33	25.28	Y
or43	N	5.10	0.35	28.80	Y	5.60	0.37	34.47	48	5.38	0.37	45.39	Y	T1_or43	ns	na	na	na
														T2_ii1	5.33	0.45	35.85	Y
														T2_ii2	5.46	0.49	38.80	Y
														T2_ii3	5.43	0.50	39.57	Y
														T2_ii4	5.19	0.48	38.11	Y
														T2_ii5	4.74	0.45	35.86	Y

														T2_ii6	5.14	0.40	31.84	Y
														T2_dc13	ns	na	na	na
														T2_dc14	5.22	0.40	32.29	Y
														T2_dc15	5.56	0.42	33.05	Y
														T2_dc20	5.77	0.34	26.40	Y
														T2_id29	5.71	0.40	31.26	Y
														T2_id30	5.65	0.43	34.04	Y
														T2_bd33	5.86	0.41	31.78	Y
														T2_r37	5.33	0.35	27.52	Y
														T2_r38	5.46	0.40	31.42	Y
														T2_or43	5.63	0.30	23.91	Y
		Scale				Scale				Scale				Scale				
H and Z			0.45	99.15			0.47	118.20			0.46	154.76				0.39	112.90	
Alpha		0.92				0.92				0.92					0.94			

6.2.2 The results

Following the stages described above, the researcher conducted four MSAs using the four configurations of data matrices discussed above. As is hypothesised in H1, the results from stages one and two show a stable dimensional structure of collective efficacy. Showing in Table 6-5, in both T1 and T2, team efficacy had a very strong unidimensional structure (HA=.81; HB=.81) and strong internal consistency (alphaA=.93; alphaB=.94) with no indications of any item violating the assumption of monotonicity. Comparing the results from both T1 and T2, there was no sign of dimensional instability. In the next stage, MSA was conducted on the stacked matrix, and the results again confirmed a very strong unidimensional structure of collective efficacy (HC=.81) and monotonicity with very good internal consistency (alphaC=.94). These results demonstrate that Collective Efficacy represents a strong unidimensional structure with good internal consistency even when taking into account potential inter-individual differences. In the third stage, using data matrix D, the results show a decline in the coefficient of homogeneity (HD=.62) and a slight decrease in its internal consistency (alphaD=.92). Nevertheless, the scale still shows a strong unidimensional structure with good reliability measure. In other words, compared to the inter-individual differences, intra-individual changes highlight the existence of a source of minor dimensional instability for collective efficacy. This instability reflects that the individual has understood the items slightly differently at the end of their team project compared to when they had just started the project. Notwithstanding the minor decreases in the H value, the results from all four data matrices support the view that the scale of collective efficacy has a stable unidimensional structure. Moreover, there were no deviations from this general pattern for any of the individual items.

Table 6-6 reports the results from a similar series of MSA analyses discussed above to the Team Flow Core (TFc) scale items. These items form a moderate to strong unidimensional scale (HA=.49; HB=.50) with monotonous items and good internal consistency (alphaA=.92; alphaB=.92) at both T1 and T2. In the second stage, the stacked data matrix confirms that this unidimensional stability (HC=.50; alphaC=.92) holds considering all inter-individual differences.

However, the analysis of the wide-form dataset in the third stage demonstrates that the intra-individual changes introduced by item 1 and item 12 of the TFc are influential; meaning that they do not reflect the same underlying dimension as the other items across time, nor their respective counterparts at T2. In sum, the TFc shows a moderately stable unidimensional structure with eleven monotonous items (HD=.48; alphaD=.95) across time. The two nonscalable items were removed from the subsequent analysis.

Similar to the previous analyses for Collective Efficacy and TFc, Table 6-7 reports the equivalent analyses for the nine items of Team Flow Antecedents (TFa) scale. The results show a very stable unidimensional structure with monotonous items reflecting a strong internal consistency across time. In stage one, MSA reveals that the scale shows a similarly strong unidimensional structure at both time 1 and time 2 (HA=.55; HB=.57). In stage two, using the stacked data matrix, the dimensionality of the TFa is not influenced by inter-individual differences (HC=.50). In stage three, there is a slight decrease in the coefficient of homogeneity (HD=.46) using the joint data matrix. Nevertheless, the scale still shows a highly acceptable unidimensional structure taking into account the intra-individual changes across time. All four scales show a reliability in excess of .92.

The 16 items CZPD questionnaire was subjected to the same three-stage approach applied above in order to test its dimensional stability. Showing in Table 6-8, in stage one, the scale displayed a relatively stable unidimensional structure from the T1 to T2. Apart from item dc13, which appeared to be unscalable on either occasion, the analysis demonstrated that CZPD has a moderately strong unidimensional structure (HA=.45; HB=.47) with twelve monotonous items that exhibit very good internal consistency (alphaA=.92, alphaB=.92). MSA produced similar results using the stacked data matrix in stage two. Again, apart from dc13, the twelve other items constitute a moderately strong unidimensional structure (HC=.46) that is stable when taking into account the interindividual changes as a source of dimensional instability. The items also show monotonicity and good internal consistency (alphaC=.92). However, in the third stage, the analysis of its intraindividual changes shows deviations from the other three configurations of data matrices. Item ii1, ii6 and or43 from T1 were not scalable. The item dc13,

unsurprisingly, was not scalable on either occasion. In sum, the scale showed weak to moderate unidimensionality (HD=.39) with good internal consistency (alphaD=.94). The four nonscalable items were removed from the subsequent analysis.

6.3 Discussion, conclusion and future direction

Following the pilot study discussed in Chapter IV, a two-wave longitudinal quantitative study was conducted to investigate the hypothesised PBrTF model. In order to produce an accurate estimate of the hypothesised causal relationships, a panel analysis has to include an *autoregressive effect* that assumes that interindividual differences, intraindividual differences and intraindividual changes across time are stable. Therefore, to examine the dimensional stability of the measurement tools, before testing the hypothesised model, MSA was conducted on four types of data matrices that were configured to represent the three-dimensional data in various two-dimensional forms, preserving the information of intra-individual changes in a matrix of interindividual or intraindividual differences.

The scales of Collective Efficacy, the TFc, the TFa and the CZPD were subjected to MSA analysis. The results showed that the Collective Efficacy and the TFa Scale displayed the strongest dimensional stability over time as both measurements formed moderate to high-level unidimensional scales in all four data matrixes. All items were monotonously nondescending and had good internal consistencies. These results demonstrate the absence of any discernible differences in participants' perceptions of the items as a result of the time elapsed between the two administrations of the questionnaires or of other factors during that time period. This stability in dimensionality allows the accurate estimate of parameters between the cause and effect variables in a panel analysis. It also demonstrates the absence of potential threats to the construct validity of these measures and their repeated measurement. (Shadish, Cook & Campbell, 2001).

The stability analysis of the TFc and the CZPD, on the other hand, revealed minor deviations in some of the items. For TFc, the results showed that item 1 and item 12 at T1 were non-scalable. This suggests that participants'

perceptions of these two items changed somewhat over time. In other words, items 1 and 12 of the TFc do not have acceptable stability over time. The wording of the items might provide some explanation here. Item 1 states "*When my team is working on the project, we think about nothing else*." The statement of "*thinking about nothing else*" indicates a hyper-concentrated state of consciousness that is closely related to high performance but also rarely lasts for an extended period. This item was devised to reflect the high concentration/absorption aspect of workplace flow experience (Bakker, 2005; 2008). As discussed in Chapter II, team flow is a state, not a trait, which is fragile and easily interrupted (Armstrong, 2008). Also, reflecting on study 1, a participant described that team flow is a rare and fragile occasion which disappears when one thinks about it. Therefore, it is understandable why this item is sensitive to the differences in perceptions introduced by the time lag. For instance, it is possible that at the beginning of the project when the survey was distributed for the first time, some of the teams were still in the *Team Formation* stage of the team developmental cycle (Kozlowski & Bell, 2013) and had many things that needed to be settled apart from the task-related issues. It is difficult for a team to be "*thinking about nothing else*" at this early stage. Therefore, item 1 might have sounded like an irrelevant descriptor of teamwork for the participants at that time. However, by the end of the team development process when the survey was distributed for the second time, most teams will have already achieved team compilation, and the collective unit of a team mentality will have emerged. After the teams had to sort out most of the task-irrelevant problems and as the deadline draws closer, the team's attention is absorbed by the immediate challenge of accomplishing the task. The intense experience of "*thinking about nothing else*" is more likely to occur. Therefore, item 1 becomes more connected to the underlying phenomenon of flow, at a later stage of a team's lifecycle. In other words, item 1 is more valid at time 2 than at time 1.

Item 12 of TFc taps into the intrinsic motivation aspect of the flow experience, which implies that "*When we are working on the project, we are doing it for ourselves*." The reason that this item is sensitive to the influence of time lag in people's evaluations is possibly related to the sense of ownership of the tasks. As the teams sampled are university student teams assembled to finish a course

work assignment, like project teams in the workplace, their tasks are pre-determined. Team members are driven more by extrinsic reasons such as the attainment of course grades. A sense of ownership of the project, therefore, would not be of much relevance at the beginning. However, as the team invests more time and energy into the project, people's involvement grows. A sense of ownership develops as members identify their connection with the end product and to their team. Intrinsic motivation develops and spreads amongst members of high-functioning teams with the potential to have team flow emergence. As a result, it is more likely that at the time when the survey was distributed for the second time, item 12 becomes more relevant and resonates with the experience of team flow. Item 1 and 12 were therefore removed from further analysis.

Like the other three measures, CZPD demonstrated a relatively stable unidimensional structure with minor deviations. Item dc13 failed to scale at all using any of the four data matrix configurations. This consistent failure indicates that there is a fundamental distinction in the perception of this item between the pilot study sample and student team sample. As the student teams sample is considerably larger than the sample of the pilot study, and that that the former more closely resembles workplace project teams, the results from the student teams sample are therefore more generalizable to the intended population. Thus, the researcher has decided to remove *dc13* from the final analysis. Also, using the joint data matrix, item *ii1*, *ii6* and *or43* at T1 failed to load on the same scale as its counterparts at T2. These results indicate that these three items show instability due to an intraindividual change. Item *ii1* states "*When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation).*" This statement reflects the idea interaction aspect of CZPD, which describes communication density and approaches of a team. When a team first assembles, and members are not as familiar with each other, it is expected that communication and exchange of ideas are limited and remain largely at the dyadic level, if not at the individual level, as theorised in the team compilation model (Kozlowski & Bell, 2013). Describing their team's communication as "*members often make an effort to present their individual ideas to the team*" might be considered by participants as an overstatement or perhaps even irrelevant as such

an intense level of idea exchange often occurs closer to the project deadline when the team collaborates more closely.

Item *ii6* suffers from similar instability in terms of intraindividual changes. The item states, "*When discussing a specific problem, a resolution to the problem is reached by combining each other's ideas.*" Item ii6 is another descriptor of communication styles in a team, and specifically pertains to the decision-making style of a team. Although there are always things that need to be decided, members do not always need to combine everyone's idea to reach a decision. In the beginning, a team is more likely to resort to reaching an agreement by the majority, which might explain why item ii6 failed to scale at T1.

Item *or43* states that: "*We gained a sense of ownership of the end product.*" This item taps into the decentralised control aspect of CZPD, emphasising the development of ownership as a result of member empowerment and engagement. Similar to the item 12 in WOLF, *Or43* failed to scale at T1 due to cross-time development because it takes time and effort to develop a sense of ownership over the project, especially in the case of project teams who are assigned a task to complete. Therefore, the question asked by *or43* could be confusing or irrelevant at the start of the team life cycle.

There has long been a debate over the dimensionality of the original TFc, which is the Work-related flow inventory (WOLF) designed by Bakker (2005, 2008). The WOLF was intended to have a three sub-dimensional structure that comprises absorption, enjoyment and intrinsic motivation. Salanova et al. (2003) and Salanova et al., (2014), however, found a two-dimensional structure having the best fit and the authors, therefore, proposed that the intrinsic motivation dimension might be better considered as a precursor to the core flow experience rather than a part of it. However, these aforementioned studies all employed factor analysis on Likert-scale items, which might have overdimensionalised the WOLF and as a consequence, subjected it to a debate over the true conceptual distinctions between its subdimensions as a result of the artefacts factor analytic techniques. As discussed by van der Eijk and Rose (2015), overdimensionalisation could result in unjustifiable conceptual distinctions which also damage the reliability and

comparability of a construct. By using an IRT model, the findings of the present study have partially supported the original proposition, demonstrating that TFc has a stable and robust structure which includes all three aspects, including *absorption*, *enjoyment and intrinsic motivation*. However, TFc is a unidimensional scale, not a composite scale with three subdimensions.

The same argument can be made for the Flow Antecedents questionnaire. *The balance between skill and challenge*, *goal clarity* and *immediate feedback* are three aspects that promote the occurrence of a flow experience (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009). Apart from Tenenbaum et al., (1999), who used a Rasch model to test the item difficulties of the Flow State Scale (FSS), the literature suggested that most research has used this measure either as a unidimensional structure or as three separate sub-dimensions without explicit examination of its dimensionality. Moreover, theoretically speaking, the original Channel Model of Flow has placed much emphasis on the importance of the *balance between skill and challenge* aspect alone, giving little attention to *goal clarity* and *immediate feedback*. The MSA results from the present study suggest that, based on an IRT model, the three aspects of flow antecedents form a unidimensional scale that is stable in structure across time.

Based on the results and the considerations discussed above, and to ensure that all measures employed in the subsequent analyses have acceptable dimensional stability, the researcher decided to remove the problematic items from the TFc and CZPD. Therefore the adjusted TFc now has eleven items, and the adjusted CZPD has twelve items (See Table6-9, and 6-10 for details.).

Table 6- 9: CZPD scale (12-item version) to be used in study 4.

Label	Full question text	Response categories
ii2	When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas.	1 (Never) to 7 (Always)
ii3	When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement.	1 (Never) to 7 (Always)
ii4	When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.	1 (Never) to 7 (Always)

Ii5	When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.	1 (Never) to 7 (Always)
dc14	All team members collectively decide on the way to carry out this project.	1 (Strongly Disagree) to 7 (Strongly Agree)
dc15	The end-product of your team project is the outcome of a collective decision-making process among team members.	1 (Strongly Disagree) to 7 (Strongly Agree)
dc20	Members have the freedom to influence the end-product.	1 (Strongly Disagree) to 7 (Strongly Agree)
id29	Members contribute ideas and/or suggestions voluntarily.	1 (Strongly Disagree) to 7 (Strongly Agree)
id30	Individual contributions add to the diversity of ideas within the team.	1 (Strongly Disagree) to 7 (Strongly Agree)
bd33	The end-product of the project is the outcome of a collective effort.	1 (Strongly Disagree) to 7 (Strongly Agree)
r37	The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry specific language and terminologies, jargon	1 (Strongly Disagree) to 7 (Strongly Agree)
r38	Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.)	1 (Strongly Disagree) to 7 (Strongly Agree)

Table 6- 10: Perceived team flow core experience scale (TFc, 11 item version) to be used in Study 4.

Label	**Full question text**	**Response categories**
T_WOLF_1	When my team is working on the project, we think about nothing else.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF _2	We get carried away by our work.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF _3	When my team is working on the project, we forget everything else around us.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_4	We are totally immersed in our work.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_5	Our work gives us a good feeling.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_6	We do our work with a lot of enjoyment.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_7	We feel happy during our work.	1 (Strongly Disagree) to 7 (Strongly Agree)

T_WOLF_8	We feel cheerful when we are working.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_9	We would still do this work even if it's not assessed.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_10	We found that we also want to work on this project in our free time.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_11	We work because we enjoy it.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_12	When we are working on the project, we are doing it for ourselves.	1 (Strongly Disagree) to 7 (Strongly Agree)
T_WOLF_13	We get our motivation from the work itself, and not from the reward of it.	1 (Strongly Disagree) to 7 (Strongly Agree)

6.4 Chapter summary

In summary, study 3 in this chapter has examined the dimensional stability of the four scales employed in a two-wave longitudinal design. The results indicated that all four scales have demonstrated an acceptable level of dimensional stability with two items from TFc and four items from CZPD showing minor deviations. Based on these findings, the researcher has decided to remove these problematic items from the TFc and CZPD for the final study in this research.

CHAPTER VII: STUDY 4 TESTING THE HYPOTHESISED PSYCHOLOGICAL AND BEHAVIOURAL RESOURCES MODEL OF TEAM FLOW (PBrTF)

7 Overview

In the preceding chapter, the researcher tested the dimensional invariance of all the measures to be used in subsequent analyses, considering potential incomparability generated by interindividual differences, intraindividual differences and intraindividual changes. The results suggest that apart from minor deviations in a few items in the CZPD and TFc, in general, the four measures have demonstrated satisfactory dimensional stability across the time lag, which serves as a solid foundation for testing the hypothesised PBrTF model in study 4. Based on the previous study, this chapter discusses the study design and procedures for testing causal propositions and then goes on to develop and estimate a causal model. These findings will be reported and discussed accordingly.

7.1 Testing the causal relationships of the hypothesised PBrTF model

7.1.1 Study overview

In this study, the hypothesised PBrTF causal model (referred to as the casual model hereafter) is tested using a panel design of structural equation modelling (SEM). In SEM, a panel design utilises longitudinal quantitative data to assess the adequacy of a hypothesised model. This study aims to examine the hypothesised causal relationships between CZPD, collective efficacy, team flow and team flow antecedents. As the data are multi-dimensional and multi-level, before testing the full SEM model, the researcher also tests the equilibrium of the data at the level of the latent variable as part of the preliminary analysis in order to demonstrate that similar relationships can be assumed across the time lag. In addition, the researcher demonstrates that the practice of aggregating individual-level data to team-level data is empirically justifiable. The term equilibrium and the practice of data aggregation will be explained in detail in section 7.2.1 and 7.2.2.

7.1.2 Study Design

The study questionnaire was distributed twice: at the beginning of the team project and at the end of the project. With permission from tutors, the researcher went along to their lectures to invite potential participants to take part in the study about one or two weeks after the teams were assembled. After explaining the purpose and design of the study, team members who were willing to participate were given information sheets and consent forms. After having given written consent, participants completed the survey for the first time. At the end of their team project, the researcher went to their classes to distribute the same survey to the participants again as an after-project measure.

7.1.3 Sample, procedure and measures

As the aim of this study is to investigate the proposed causal model, the researcher used the same dataset as study 3, which was described earlier in 6.1.3. The same four variables, CZPD, perceived collective efficacy, team flow antecedents and core team flow (T_WOLF) were used.

7.1.4 Ethical considerations

This study uses the same data set as study 3 from Chapter VI. Therefore, the researcher followed the same ethical procedures. For a detailed description, refer to section 6.1.4.

7.2 Research questions and hypotheses

This study aims to explore the hypothesised causal model of team flow. The essential focus of this study and the entire project is, through identifying the team psychological and behavioural resources, to explore and understand how these resources can promote the experience of team flow, an enjoyable collective state of consciousness that leads to optimal team performance and member wellbeing. Employing a longitudinal SEM model, the researcher aims to test three

pairs of casual relationships in the PBrTF model (Figure 7-1). Based on the IMOI framework of team effectiveness (Mathieu et al., 2008), it is emphasized that there is a feedback loop between team social resources (i.e. CZPD and team efficacy) and team effectiveness indicators such as team flow and that this feedback loop is sustained throughout the lifespan of a team. In this way, IMOI lays down the foundation for an internal dynamic that describes a team. However, IMOI does not propose a possible general trend for this causal dynamic. In other words, a feedback loop between any phenomena emerged in a team can be mutually reinforcing and forming an upward spiral, or mutually defeating to form a downward spiral or neither. However, considering the positive nature of the constructs of interest and in light of the Broad and Build theory (Fredrickson, 2004), it is hypothesised that these three pairs of variables and team flow antecedents are expected to be mutually beneficial, perpetuating and promoting an upward spiral in the context of a team which improves team performance and member well-being.

As discussed in Chapter II, based on the Social Cognitive Theory (Bandura, 1977), Salanova and her colleagues (2014) have proposed an Extended Channel Model of Flow, providing evidence that team efficacy is a type of team resource which promotes the experience of team flow by improving the perceived balance between skill and challenge. The PBrTF model the researcher proposes here is based on this Extended Channel Model of Flow. Specifically, in addition to team efficacy, the researcher proposes another team behavioural resource -- the collaborative zone of proximal development (CZPD). CZPD outlines the communicative and collaborative dynamics that feature in a self-organising unit capable of sustainable improvement of its competence through peer-learning. Therefore, based on the discussion in the literature review, the researcher posits the following research questions and hypotheses:

Research question 1: Do team flow and team efficacy have a positive reciprocal relationship, i.e. in that teams that possess a higher level of task-specific confidence are more likely to experience team flow and vice versa?

It is hypothesised that there is a positive, reciprocal causal relationship between team efficacy and team flow. Specifically, that, (H1a)

team efficacy level at the beginning (T1) of a team project (positively) predicts the perceived team flow at the end (T2) of a team project; (H1b) and team flow level at the beginning (T1) of a team project (positively) predicts the perceived team efficacy at the end (T2) of a team project.

Research question 2: Does team efficacy promote the experience of team flow through its positive effect on team flow antecedents?

It is hypothesised that (H2a) team efficacy at the beginning (T1) of the team project (positively) predicts the level of team flow antecedents at the end (T2) of the project; (H2b) team flow antecedents at the beginning (T1) of the team project (positively) predict the level of team flow at the end (T2) of the project; (H2c) team flow antecedents mediate the relationship between team efficacy and team flow.

Research question 3: Do team flow and CZPD have a positive reciprocal relationship, i.e. in that teams with a higher level of CZPD are more likely to experience team flow and vice versa?

It is hypothesised that there is a positive, reciprocal causal relationship between CZPD and team flow. Specifically, that (H3a) CZPD at the beginning (T1) of a team project (positively) predicts perceived team flow at the end (T2) of a team project; (H3b) and team flow level at the beginning (T1) of a team project (positively) predicts the CZPD at the end (T2) of a team project.

Research question 4: Does CZPD promote the experience of team flow through its positive effect on team flow antecedents?

It is hypothesised that (H4a) CZPD at the beginning (T1) of the team project (positively) predicts the level of team flow antecedents at the end (T2) of the project; (H4b) team flow antecedents mediate the relationship between CZPD and team flow.

Research question 5: Do CZPD and team efficacy have a positive reciprocal relationship, i.e. in that teams possess a higher level of task-specific confidence would have a higher level of CZPD and vice versa?

It is hypothesised that there is a positive, reciprocal causal relationship between CZPD and team efficacy in that, (H5a) team efficacy level at the beginning (T1) of a team project (positively) predicts CZPD at the end (T2) of a team project; (H5b) and CZPD at the beginning (T1) of a team project (positively) predicts the perceived team efficacy at the end (T2) of a team project.

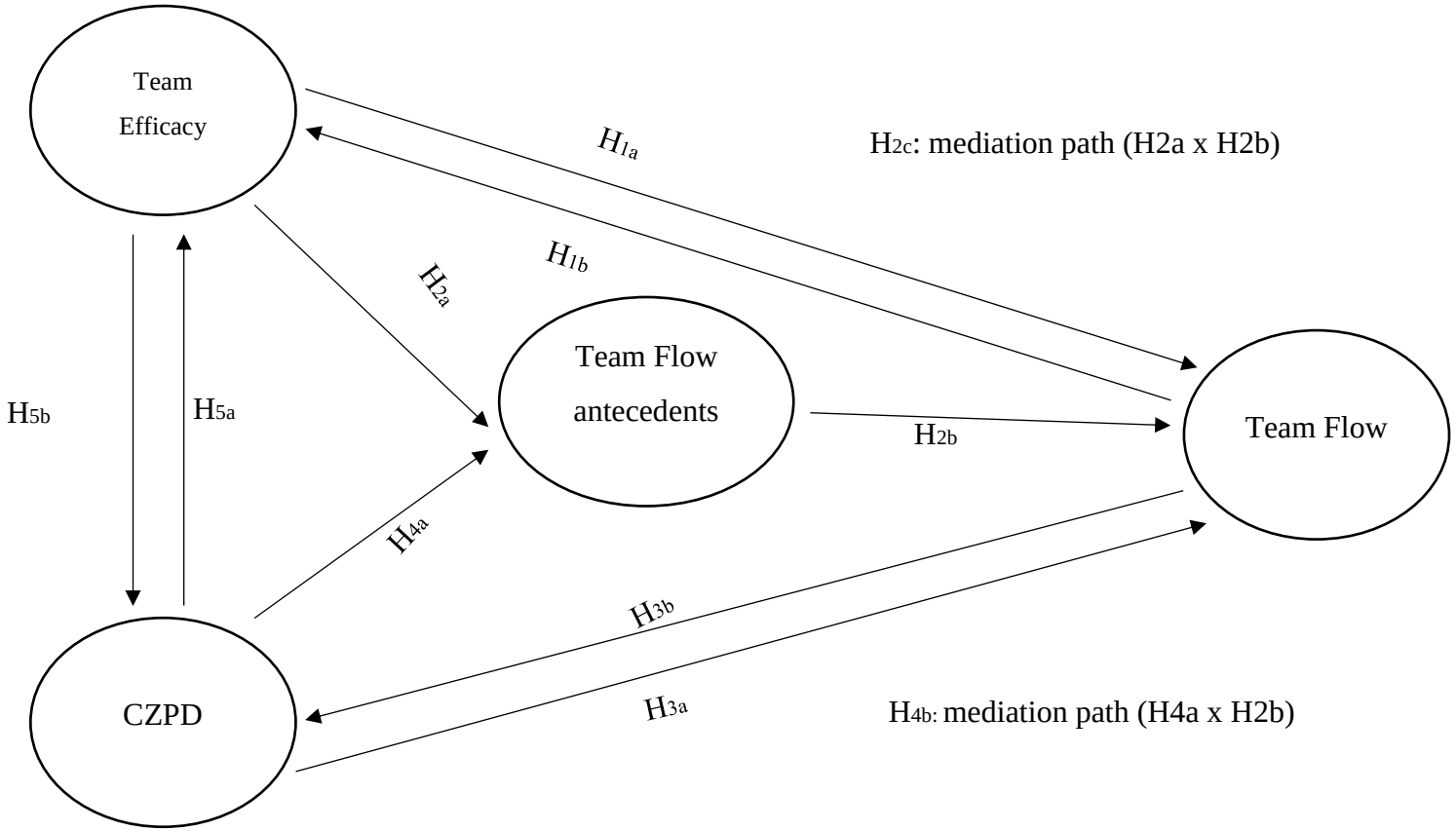


Figure 7- 1: The stylised proposed PBrTF model (the causal model) numbered with hypotheses

7.2.1 Method

7.2.1.1 Structural Equation Modelling

To test the hypothesised model, the researcher decided that the most suitable and robust method would be to use structural equation modelling. Structural equation modelling (SEM) is a multivariate statistical analysis technique that comprises two elements: the measurement part and the structural part (Bentler, 2006). SEM is a linear model that estimates the relationships between variables simultaneously, and can analyse both observed variables in a path model and latent variables in a full SEM (Byrne, 2013). The measurement model estimates the relationship between the observed variables (items) and the latent construct that drives the responses to the items. The structural model can estimate a set of direct and/or indirect relationships between the variables, both observed and unobserved (Schreiber, Nora, Stage, Barlow, & King, 2006). SEM is usually the preferred option for analysing complex research questions that examine relationships between a number of dependent and independent variables.

In a full SEM, the measurement model portion is usually analysed using confirmatory factor analysis (CFA) as a default. It is desirable for a construct to be unidimensional in SEM. As mentioned in the discussion on Mokken Scale Analysis (section 5.3), the property of unidimensionality of a scale ensures that it reflects a single latent concept to ensure accuracy. Ideally, each item in a scale should have its unique variance to make sure that the concept is represented broadly enough and at the same time, share with all the other items in the scale a covariance that represents the common variance driven by the latent construct. In a CFA, the unique variances of all the items in a scale are assumed to be random errors which are normally distributed, uncorrelated and with a mean of zero (Bentler, 2006). Therefore, the advantage of CFA is that by estimating the unique variances of all items in a scale, CFA isolates the "true" value (common variance) from the random noises. As a result, CFA obtains a more accurate measure of a latent variable. Moreover, with this improved measurement, it is more likely to have a robust and strong result for the structural model because random errors have no explanatory functions. The advantage of latent variable modelling

techniques such as SEM is evident; however, as discussed in study 2, factor analysis including CFA is not suitable for analysing Likert-scale items (van de Eijk & Rose, 2015). To remedy this shortcoming of CFA, the researcher used a technique, which splices an IRT model to replace CFA in SEM. See section 7.2.1.3 for detailed explanations.

7.2.1.2 Goodness-of-fit-indices

To assess the fit of a model, SEM compares the observed covariance matrix of the variables included in the proposed theoretical model, the measurement and the structural part, with the covariance matrix that would exist if the estimated model parameters are absolutely correct. There are two main types of the goodness of fit indices: the absolute fit indices and the comparative indices (incremental fit index). The absolute fit indices reflect the relationship between the proposed model and the sample data. The model chi-square value ($\chi 2$) is the most frequently reported absolute fit index. Chi-Square assesses the overall fit and the discrepancy between the observed covariance matrix and the implied model covariance. As the null hypothesis is that the theoretical model fits the data perfectly, i.e. no discrepancy, the cut-off for a good fit is a *p*-value >.05 (Hu & Bentler, 1999). A significant chi-square value indicates that the discrepancy between the proposed model and the sample model is significantly different from zero—a poor fit between the sample and the theoretical model. In other words, chi-square is a badness of fit index. Moreover, as the Chi-square is sensitive to sample size in that once the sample is larger than 300 or 350, it becomes increasingly more difficult to obtain a non-significant chi-square value (Schumacker & Lomax, 2004). As a result, Hair, Black, Babin, & Anderson (2010) recommended using the Normed $\chi 2$, which is the ratio of the chi-squared value divided by its degree of freedom ($\chi 2/df$) as a measure for goodness of fit. The rule of thumb for a cut-off value for the normed chi-square is that less than 5.0 indicates adequate model fit and less than 2.0 indicates good model fit (Hair et al., 2010).

In addition to chi-square, its corresponding degrees of freedom and the Normed chi-square, the Root Mean Square Error of Approximation (RMSEA) is another commonly reported absolute fit index. RMSEA is a standardised error

approximation measure which examines the fit of the model per degree of freedom. It is recommended that RMSEA >0.1 should lead to model rejection and that RMSEA <.05 indicates good model fit. RMSEA values between these two criteria indicate a model of which the fit is uncertain. Therefore, .05 is used as the cut-off here. PCLOSE is the p-value for testing the null hypothesis of RMSEA ≤0.05, a close fit. PCLOSE >.05 indicates that a value of RMSEA ≤0.05 is significant (Browne & Cudeck, 1992). As a standardised measure, RMSEA is insensitive to sample size. It is, therefore, an ideal fit index to be reported alongside chi-square.

Comparative fit indices compare the improvement in the fit of the proposed model with the baseline model, which is the independence model that specifies the absence of any paths between variables in a model. Most comparative fit indices are a ratio between the chi-square of the model and the null model, including their degrees of freedoms (Newsom, 2012). Normed comparative fit indices range between 0 and 1, with 1 indicating a perfect fit. The most frequently reported are CFI (the comparative fit index) and TLI (Tucker-Lewis Index). Although it is worth mentioning that as a non-normed measure, it is possible for TLI to go beyond 1.0 or slightly lower than 0 (Hoelter, 1983)). For either normed or non-normed, the recommended cut-off value for these two measures is > .90 (Hu & Bentler, 1999). However, CFI and TLI are considered heuristic measures and are recommended not to be used in formal testing because no sampling distribution is known.

Considering the advantages and disadvantages of the fit indices discussed above, Hair et al. (2010) recommends using a combination of measures from different families of indices. Therefore, this research will evaluate estimated models by using χ^2 with *df* and *p*, Normed chi-square, RMSEA with PCLOSE, CFI and TLI.

7.2.1.3 Measurement models: Splicing IRT into SEM.

As the hypothesised causal model pertains only to the reciprocal relationships between the emergent team level phenomena of collective efficacy, CZPD, team flow antecedents and team flow core experience, in order to build an SEM model to test the hypotheses, the researcher followed Chan's (1998) recommendation of aggregating individual responses to the team level by using team averages. Empirical justification for data aggregation are provided in detail in section 7.2.2.2. The most common way of building an SEM model is to apply confirmatory factor analysis to the measurement components of the model. After a satisfactory CFA, a full SEM model is built by adding paths to test the relationships between variables (Acock, 2013). However, as discussed earlier (see study 2), factor analysis on ordered-categorical items risks overdimensionalisation, whereas IRT models in themselves do not offer the possibility to estimate structural coefficients. Therefore, in order to benefit from the advantages of both IRT scaling and SEM modelling, the researcher followed the approach recommended by van der Eijk (2018) which involves splicing the IRT results into SEM, thereby employing a latent variable modelling technique other than CFA for the measurement portion of SEM.

The operationalisation of splicing an IRT model into SEM is similar to the procedure of using single indicators in SEM. After obtaining a satisfactory IRT model, to create the measurement part of this latent construct, the researcher first calculates the scale score by taking the average of all the items resulted from the IRT modelling. Using this scale score, the researcher can then specify the latent variable with a single indicator. In this way, the latent variable contains all information derived from the IRT scaling. Next, instead of allowing SEM to estimate the error term freely, the researcher fixes it using the reliability value of this scale. According to Brown (2015), when a single indicator is used in SEM, its unstandardized measurement error can be fixed to a non-zero value which is calculated by the latent variable's sample variance and its value of internal consistency as its known psychometric information. The formula for calculating this unstandardized error term is: ($var_{IRT\text{-}scale\text{-}score}$ * (1-reliability)).

Thus, by replacing CFA with IRT scales, such an SEM model could benefit from the advantage of working with latent variables while not being affected by the risk of overdimensionalisation and resulting artefactual outcomes inherent

in CFA. Moreover, by splicing an IRT model into an SEM, the estimated structural coefficients include a beneficial element of a full SEM, namely the correction for attenuation of relationships generated by unreliability of observed variables. Compared to a path model using the subject score as a manifest measure, the structural parameters estimated in an SEM model incorporating the information from an IRT model is less biased, as the error term calculated isolates the random noise from the "true" variance of the latent variable.

7.2.1.4 The structural model: The causal model and the mediation model

As stated in the research questions, the study proposed three pairs of reciprocal relationships in the hypothesised causal model. In a half-longitudinal design (i.e. data collected at only two occasions: Cole & Maxwell, 2003), this reciprocal relationship is expressed in a cross-lagged panel model as A_{t-1} (exogenous variable)→ B_t (endogenous variable), and B_{t-1} (exogenous variable)→ A_t (endogenous variable). A detailed explanation of a cross-lagged panel model will be presented in section 7.2.1.5. In the structural model Figure 7-1, the three pairs of reciprocal relationships are represented by H1a and H1b (team efficacy and team flow), H3a and H3b (CZPD and team flow), and H5a and H5b (team efficacy and CZPD). See Figure 7-2 for a cross-lagged panel model as a representation of the proposed causal reciprocal relationships and the mediation paths.

According to Hayes (2017), to establish an indirect relationship, there are three conditions to fulfil: (a) a significant path *a* (independent variable → mediator); (b) a significant path *b* (mediator → dependent variable); (c) and a significant path *a* x *b*. An indirect effect in half-longitudinal design, on the other hand, is produced by multiplying the effect of path *a* (exogenous variable$_{t-1}$ → mediator$_t$) by path *b* (mediator$_{t-1}$→ endogenous variable$_t$) (Preacher, 2015). Illustrated in Figure 7-2, the two pairs of mediation paths are represented by H2a x H2b (team flow antecedents mediating the relationship between team efficacy and team flow), and H3a x H2b (team antecedents mediating the relationship between CZPD and team flow).

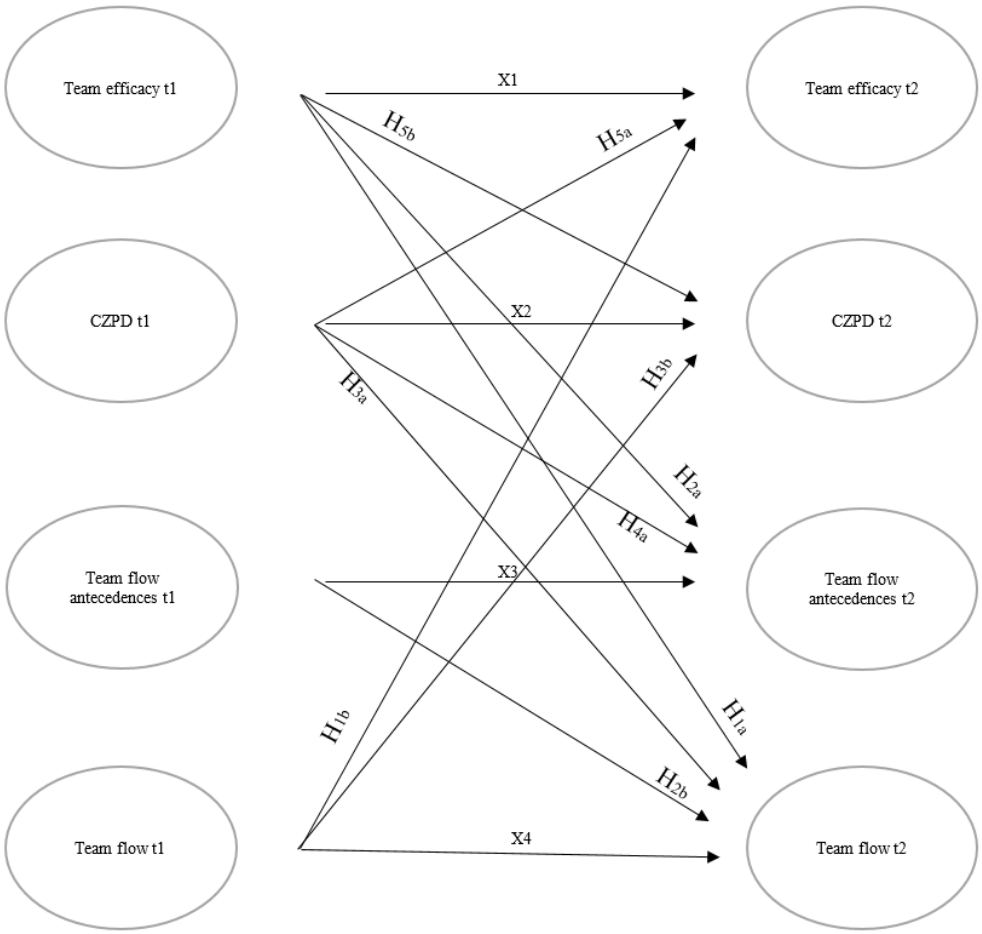


Figure 7- 2: The proposed cross-lagged panel model of a half-longitudinal design.

For simplicity, measurement errors and structural disturbance are not depicted. For the same reason, the covariances between exogenous variables are not depicted. Within the same occasion, residuals are allowed to covary across variables. Path H2a, H2b, H1a, H4a, H3a are cross-lag paths. Path x1, x2, x3, x4 are autoregressive effects. H2c: mediation path (H2a x H2b). $H4_b$: mediation path (H4a x H2b).

7.2.1.5 The structural model: assumptions for a half-longitudinal design

With clear theoretical and practical guidelines, mediation models have gained popularity in social science research, and its variations have been tested in many cross-sectional design studies (Baron & Kenny, 1986; Hayes, 2018; Preacher, 2015). However, a mediation model is inherently a causal model. In longitudinal designs, researchers are allowed to make stronger causal inferences on the relationships in mediation models. Cole and Maxwell (2003) discussed three underlying assumptions which refer to various types of changes over time relevant to mediation models in a longitudinal design, which is a cross-lagged panel model (CLPM). CLPM is an SEM model in which all variables of a mediation model

have repeated measures. Therefore in a CLPM, in addition to the causal relationships between a variable and another variable measured in a prior time, each variable also depends on its own value at a prior time (Gollob & Reichardt, 1991). This is the *autoregression effect* discussed earlier in Chapter VI. CLPM is based on three assumptions: stability, stationarity and equilibrium (Cole & Maxwell, 2003; Kenny, 1979; MacKinnon& Luecken, 2008). Stability pertains to the individual differences maintained in a variable cross time. This type of individual-level differences has already been discussed and tested in study 3 while the researcher examined the dimensionality and dimensional stability of the measures (see Chapter VI). Stationarity describes a causal structure (identical magnitudes of causal paths) that remains unchanged over time. Equilibrium refers to the stability of the cross-sectional variances and covariances over time. A system with stationarity might not have equilibrium. For example, in a reciprocal relationship, while a system has exhibited stable magnitudes of causal paths, as the system develops, its within-wave correlation or covariance might still be increasing, and would not manage to reach equilibrium in the first two or three waves (Cole & Maxwell, 2003).

In a cross-lagged panel model (CLPM), at least three measurement occasions are required. Preacher (2015) cautioned that with fewer repeated measures, fewer assumptions can be tested for the interpretation and generalisability of the indirect effects. When there are only two waves, the design is not a full CLPM but a half-longitudinal design (Preacher, 2015), such as the current study. In a half-longitudinal design, the data cannot be tested for its stationarity (Cole & Maxwell, 2003; Preacher, 2015). The common weakness of a half-longitudinal design in testing mediational models arises on two occasions: when the relationship between the independent variable and the mediator are only examined contemporaneously, or when the relationship between the mediator and the dependent variable are only examined contemporaneously. However, when the independent variable, mediator and dependent variable in a mediation model are all measured on both occasions (as in the current study), under the assumption of stationarity, the mediational effect can be estimated as the product of path *a* x *b* as discussed in section 7.2.1.4.

Therefore, following the suggestion by Cole and Maxwell (2003), the researcher tested the equilibrium assumption of the latent variable system. Using the same empirical data collected for model testing, the researcher constrained the variance and covariance of the latent variables from wave 1 and wave 2 (N=93 teams) and allowed all latent variables to correlate with each other. The comparison shows that there are no significant differences between wave 1 and wave 2 (χ^2 (10) = 15.95, p=.10, RMSEA=.08, CFI=.96, TLI=.95). The assumption of equilibrium of this half-longitudinal data therefore holds. In other words, the variances-covariance of the latent variable system in the dataset is constant across the time-lag, which suggests that the causal processes have begun from the beginning of the team project and that they have reached equilibrium as soon as the project starts (Cole & Maxwell, 2003). If equilibrium did not hold, it implies that the relationships between variables are still growing and evolving and more repeated measures are warranted for a more accurate estimation of the causal parameters.

7.2.2 Data Screening and Preliminary Analyses

7.2.2.1 Assumption testing in SEM

Based on the SEM assumptions discussed, the researcher has conducted the following assumption checks to ascertain the suitability of the current data for an SEM analysis. The means, standard divisions, reliability and bivariate correlations for CZPD, team flow (TFc), team flow antecedents (TFa) and perceived collective efficacy (CE) are presented in Table 7-1.

Table 7- 1: Means, standard deviations, reliability and correlations for the study variables.

Variables	*M*	SD	1	2	3	4	*5*	6	7	8
1.Team Efficacy-t1	5.37	.88	(0.93)							
2. CZPD-t1	5.51	.61	.75***	(0.92)						
3.Team Flow antecedents -t1	4.84	.66	.73***	.65***	(0.93)					
4.Team Flow core-t1	3.75	.95	.52***	.53***	.69**	(0.92)				
5.Team Efficacy-t2	5.54	.92	.59***	.56***	.36**	.24*	(0.94)			
6. CZPD-t2	5.58	.68	.61***	.67***	.45***	.38***	.87***	(0.92)		
7. Team Flow Antecedents-t2	5.20	.83	.55***	.58***	.56***	.47***	.837***	.85***	(0.93)	
8. Team Flow Core-t2	4.06	1.03	.42***	.46***	.61***	.78***	.53***	.58***	.75***	(0.92)

Notes: correlations are presented at the team-level. Coefficient alpha reliability estimates are listed in the diagonal in parentheses.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.000$.

As a general linear model, SEM has several assumptions: (a) to perform factor analysis and multiple regression analysis using SEM, the individual level observations are assumed to be sampled independently. As a longitudinal design, in this study, this assumption is likely to be violated because of serial correlation between individual-level observations. However, because the current study is a longitudinal design, the researcher has examined the data following the general assumptions underlying longitudinal analyses, see 7.2.1.5 for details. (b) SEM assumes unit-homogeneity (Kline, 2012), which is violated when different sample groups of individual level cases demonstrate different multivariate distributions. For example, in the case of a longitudinal design where the data are collected at multiple time points, they can be regarded as multiple sample groups. If the multivariate relationships are significantly different across these sample groups, the assumption of unit-homogeneity is violated and this implies the existence of interaction— a time-contextual effect. In this study, the data analysis was based on the assumptions for a half-longitudinal design on data stationarity (study 3) and equilibrium(discussed earlier in section 7.2.1.5), and the results show that for this dataset, stationarity and equilibrium hold and unit-homogeneity is not violated. (c) It is also assumed that in an SEM, the error terms and structural disturbance are randomly distributed and having an expected mean value of zero and a multivariate normal distribution. At the individual level, the error terms are assumed to be independent of each other and the latent variables as well. The structural disturbance is assumed to be independent of its correspondent exogenous variables. (d) SEM also assumes that the latent exogenous variables follow a multivariate normal distribution, and if an exogenous variable is manifest, it is measured without error. This is a very stringent and somewhat unrealistic assumption. Fortunately, mild violations of this assumption do not pose a severe threat for parameter estimates, particularly when estimation is performed with ADF (Arbuckle, 2014)

Homoscedasticity and linearity are assumed in all these models. Violation of these assumptions may result in biased standard errors, which leads to inaccurate conclusions about the regression coefficients significance. However, none of these consequences was apparent in the results from analyses, which

indicates that any violations would not have been overly severe. To check the assumption of homoscedasticity and linearity, a scatterplot, histogram and P-P plot using the residuals of the predictors against the predicted variable was graphed using SPSS v24. Considering the hypothesised model, four sets of multiple regressions were conducted to examine the distribution of the residuals. Using team flow at T1 and T2 as the predicted variable, and CZPD, team efficacy and team flow antecedents at both T1 and T2 as the predictors, the results show that, within T1 and T2, the assumption of homoscedasticity and linearity hold. However, violations of these assumptions were found across time lag. Cook's distance analysis was also performed using the multiple linear regression function in SPSS v24. Similar to the results before, there is no case above the threshold level of .10 within T1 and T2, which means no multivariate outlier was found (Field, 2013). The dataset has no missing data. Collinearity is checked by examining the correlation matrix. No correlation between the latent variables within the same time lag exceeds the .80 threshold (Dormann et al., 2013). However, multivariate outliers were found across the time lag. Multivariate normality checks using the *mvest* function in STATA suggests that the dataset is not multivariate normally distributed (Doornik-Hansen χ^2 (16) = 52.07, P=.000). Based on this finding, the researcher decided to use the asymptotic distribution-free (ADF) estimator to run SEM. Unlike the maximum likelihood (ML) estimator, ADF relaxes the assumption of multivariate normal distribution and is, therefore, more efficient compared to ML in this situation.

7.2.2.2 Measurement models: Data aggregation

Because all variables are conceptualised as a group-level phenomenon, while the actual observations are at the individual level, the researcher aggregated the scores of the individual members to represent the team level scores. At the survey development stage, the researcher has changed the referent of all item from "I" to "we". Based on the multilevel-theory discussed in Chapter I, Chan (1998) termed this practice as a *Referent-Shift Consensus Composition* model, which is considered the most appropriate way to operationalise a unit-level phenomenon (Klein, Conn, Smith, & Sorra, 2001). In a referent-shift consensus composition model, members belonging to the same team or unit are assumed to share similar

perceptions of a construct and that any variability observed in their responses are derived from measurement error or noise (Biemann, et al., 2012; Coombs, 1964). By shifting the referent from the individual to the collective, the aggregation of members' scores represents the collective evaluation of the unit. As discussed in the section of multilevel theory in Chapter I, a team level phenomenon emerges when the within-team agreement is higher than that of between-team agreement. Therefore, the level of homogeneity of individual team member's judgments, or their interrater agreement, can empirically justify the aggregation approach.

The researcher use *rWG(J)* (the multi-item statistics of r_{WG}), ICC(1) and ICC(2) statistics as indices of interrater agreement. *rWG(J)* was first introduced as a statistic measuring interrater reliability, which is the measure reflecting the rating consistency of multiple judges of multiple objects (Biemann, Cole and Voelpel, 2012). James, Demaree, &Wolf (1984) cautioned that, for the *rWG(j)* index to be appropriate, the measures need to have construct validity and high reliability, and that they should be unidimensional. Additionally, the measures need to be in the format of discrete responses on equal-interval scales, preferably a five or seven-point Likert-scale. The four scales used in this study satisfy all the assumptions listed here.

Alongside the rWG based indices, Biemann et al. (2012) and Lebreton, Burgess, Kaiser, Atchley, & James (2003) suggest reporting intraclass correlation coefficients (ICCs) as a form of interrater reliability to provide multiple sources of evidence to justify aggregation. Interrater agreement (IRA), such as rWG based indices, focusing on the homogeneity of the judge's ratings, while interrater reliability (IRR) examines the consistency of the judge's ratings (Kozlowski & Hattrup, 1992). ICC(1) represents the amount of variance in a variable that is the result of being a member of a group. ICC(1) can be used as an effect size estimator (Bliese, 2000) and a statistically significant ICC(1) serves as empirical evidence indicating that a variable can be studied sensibly at the unit level (Chen, Mathieu, & Bliese 2004). ICC(2) represents the emergence of unit properties and is the reliability measure of the aggregated group means, which can be used to distinguish groups (Bliese, 2000).

Integrating the pros and cons of these three types of interrater agreement indices, Biemann et al., (2012) has proposed a three steps best practice approach for reporting aggregation results.

Step 1: calculate the rWG value using the rectangular null distribution as the upper-boundary of the within-unit agreement. For the lower boundary, it is necessary to identify alternative null distribution. However, as the constructs used in this project are not well-studied, there is limited empirical evidence from prior studies to base on. The researcher decided to use the alternative null distributions based on theoretical rationale (Biemann et al., 2012; Lebreton et al., 2003). Therefore, the researcher assumed heavy skew distribution for Team Efficacy because the items tend to describe a socially desirable situation, especially when members are all sitting together during questionnaire distribution. For Team Flow items, the researcher assumed slight skew distribution because, the items from the absorption and intrinsic motivation aspects do not sound as socially desirable as their counterparts from Team Efficacy, although participants might be prone to choose the higher end of the scale on items from an enjoyment aspect. The researcher used moderate skew for Team Flow Antecedents as members tend to think positively about their challenge/skill perception, goal clarity and feedback clarity. Finally, based on the same anticipation, the researcher assumed moderate skew for CZPD because a moderate level of social desirability entailed in some of the items.

Step 2: to calculate and interoperate the interrater agreement. LeBreton & Senter (2008) and Brown & Hauenstein (2005) suggested that instead of using .70 as an arbitrary cut-off point to classify interrater agreement as high or low, rWG and rWG(j) can be interpreted as: "lack of agreement=.00 to .30; "weak agreement"=.31 to .50; "moderate agreement"=.51 to .70; "strong agreement"=.71 to .90, and; "very strong agreement"=.91 to 1.00" (Biemann et al., 2012, p73).

Step 3: report the intraclass correlation coefficients (ICCs). A value of ICC (1) between .05 and .20 is considered acceptable, and ICC (2) is generally required to be above .80 (Bliese, 2000).

Based on the above suggestions, the researcher calculated the relevant aggregation indices (See Table 7-2). The results show that based on a rectangular null assumption, all measures used at both time waves have an average rWG(j) of above .80, indicating strong within team agreement. The rWG(j) values of all four measures across the two time points based on specific null assumption also indicate moderate to strong agreement. The ICC(1) values range between .22 to .47, which are all statistically significant. The ICC(2) values are all on the low end, ranging between .51 and .77. However, because ICC(2) tends to be less reliable with small groups (Bliese, 1998), and some of the teams have only three members, the ICC(2) measure obtained here is not considered as optimal. Based on all the above results, the researcher decided to proceed with data aggregation.

Table 7- 2: Aggregation results for consensus composition models.

Measure	rWG(J).uniform			rWG(J).measure-specific					
	Mean	SD	shape	S^2E	Mean	SD	F-ratio	ICC(1)	ICC(2)
Team efficacy t1	0.87	0.19	Heavy skew	2.14	0.70	0.34	2.65***	0.31	0.62
Team efficacy t2	0.87	0.21	Heavy skew	1.39	0.55	0.40	3.22***	0.37	0.69
Team flow core t1	0.91	0.15	Slight skew	2.90	0.82	0.26	4.39***	0.47	0.77
Team flow core t2	0.83	0.27	Slight skew	2.90	0.70	0.35	3.52***	0.40	0.72
Team flow antecedents t1	0.93	0.14	Moderate skew	2.90	0.87	0.19	2.04***	0.22	0.51
Team flow antecedents t2	0.91	0.20	Moderate skew	2.14	0.74	0.35	3.10***	0.36	0.68
CZPD t1	0.97	0.07	Moderate skew	2.14	0.86	0.26	2.93***	0.34	0.66
CZPD t2	0.95	0.14	Moderate skew	2.14	0.82	0.30	3.10***	0.36	0.68

Notes. SD = standard deviation of rWG(J) values; shape = the shape of an alternative null distribution; S^2E = variance of an alternative null distribution. Variance estimations for measure-specific null distributions (i.e., slight skew, normal, and moderate. skew) were taken from LeBreton and Senter (2008, p. 832). *** p<.000.

7.2.3 Model Testing

7.2.3.1 The hypothesised PBrTF causal model

SEM can be carried out using a graphical function or using commands in STATA v15. To specify and estimate the hypothesised model in SEM, the researcher aggregated the data to the team level. The variables included were team efficacy, CZPD, team flow antecedents and team flow core experience at both T1 (N=93) and T2 (N=103). Considering the data did not have multivariate normal distribution (see discussion in 7.2.2.1), the researcher decided to use the asymptotic distribution-free (adf) estimator. There were 30 observations with missing values excluded, yielding a total of 84 teams in the analysis at both measurement occasions (T1 and T2). The researcher hypothesised that there would be three pairs of reciprocal relationships, between team efficacy and CZPD, team efficacy and team flow core experience, and CZPD and team flow core experience. The researcher also hypothesised two sets of mediation effects: team efficacy influences team flow through its effect on team flow antecedents. Similarly, CZPD influences team flow through its effect on team flow antecedents (see Figure 7-4 for the cross-lagged panel model). The researcher first tested the hypothesised model. The results showed that the structural model fits the data very well (See Table 7-3), and all measures are relatively stable over time. The coefficients of the autoregressive effects are: CE (β= 0.48, p = 0.001), CZPD (β = 0.44, p < 0.000), TFc (β = 0.63, p < 0.000) and TFa (β = 0.40, p < 0.000). These results reflect the findings from Study 3, which indicate dimensional invariance in all the variables measured over the duration of the team project. However, none of the hypothesised reciprocal relationships was supported, and neither of the two mediation paths was supported. Only three statistically significant paths were contained in this model. (1) Team flow experience at the start of the project negatively predicts team efficacy beliefs at the end of the project (H1b, TFc1→CE2: β = -.17, p = 0.001). This result, however, was in the opposite direction as the original hypothesis. (2) Team efficacy beliefs at the beginning of the project positively predict CZPD at the end of the project (H5a, CE1→CZPD2: β = .31, p = 0.003), supporting H5a. (3) Team flow antecedents at the beginning

of the project positively predict team flow experience at the end of the project (H2b, TFa1→TFc2: β = .19, p = 0.004), supporting H2b.

Table 7- 3. SEM models goodness of fit

Model	Goodness of fit indices									
	$\chi 2$	*df*	p	$\chi 2/df$	RMSEA	PCLOSE	CFI	TLI	$\Delta\chi 2$	Δdf
M1.	1.38	3	.71	.46	.00	.77	1.00	1.08		
M2.	2.75	6	.84	.46	.00	.90	1.00	1.08		
M2-M1									1.37[ns]	3

Notes: $\chi 2$ = chi-square; *df* = degrees of freedom; RMSEA = root Mean square error of approximation; PCLOS= p value of RMSEA, CFI= Comparative Fit Index; TLI=Tucker-Lewis Index.
M1= The hypothesised PBrTF causal model.
M2 = The Parsimonious model
ns = not significant.

7.2.3.2 The Parsimonious model

As the hypothesised model contains six non-significant structural paths out of thirteen paths in total, which amounts to nearly half of the hypothesised relationships, for the sake of parsimony, the researcher decided to adapt the model by pruning non-significant paths to improve model fit and reach a more parsimonious solution. By deleting only the path with the highest p values each time, the researcher removed three non-significant paths in an iterative manner until arriving at the pruned model (M2 in Table 7-3), which no longer contains any non-significant paths. After adaptation, there are ten paths in the pruned model in total which appear to fit the data very well (See Table 7-3). With respect to the stability in individual differences in the chosen variables, all measures still showed good cross-time stability: CE (β= 0.46 [.31, .60], p < 0.000), CZPD (β= 0.40 [.24, .56], p < 0.000), TFc (β = 0.63 [.50, .75], p < 0.000) and TFa (β = 0.48 [.36, .60], p < 0.000). Two pairs of hypothesised reciprocal relationships were significant. Specifically, it was found that the early team efficacy beliefs negatively predict team flow experience at the end of the teamwork (H1a, CE1→TFc2: β= -.17 [-.31,-.02], p = 0.02) and that conversely, early team flow experiences negatively predict team efficacy beliefs at the end of the team project (H1b,

TFc1→CE2: β = -.15 [-.23, -.07], p < 0.000). These results were in the opposite direction as H1a and H1b. It was also found that team efficacy beliefs measured at the beginning of teamwork positively predicts team CZPD status at the end of the teamwork (H5a, CE1→CZPD2: β = .30 [.18, .42], p < 0.000) and that CZPD status positively predicts the team efficacy level at the end of the teamwork (H5b, CZPD1→CE2: β = .23 [.06, .40], p = 0.007, thus supporting H5a and H5b). The reciprocal relationship between CZPD and team efficacy is stronger than the reciprocal relationship between team efficacy and team flow. Also, it was found that CZPD at the beginning positively predicts perceived team flow antecedents at the end of the teamwork (H4a, CZPD1→TFa2: β =.19 [.04, .33], p =.01). Levels of perceived team flow antecedents at the beginning of the teamwork were also found to positively predict team flow experience at the end of team project (H2b, TFa1→TFc2: β = .32 [.14, .49], p < 0.000). Team flow antecedents is found to be the strongest predictor of team flow. Based on Preacher (2015), the parameter for the mediation path H4b equals the product of H4a x H2b, β = .06 (z=2.14, p=.03), which is statistically significant. The calculation was conducted using the Sobel test (Preacher, & Leonardelli, 2001).

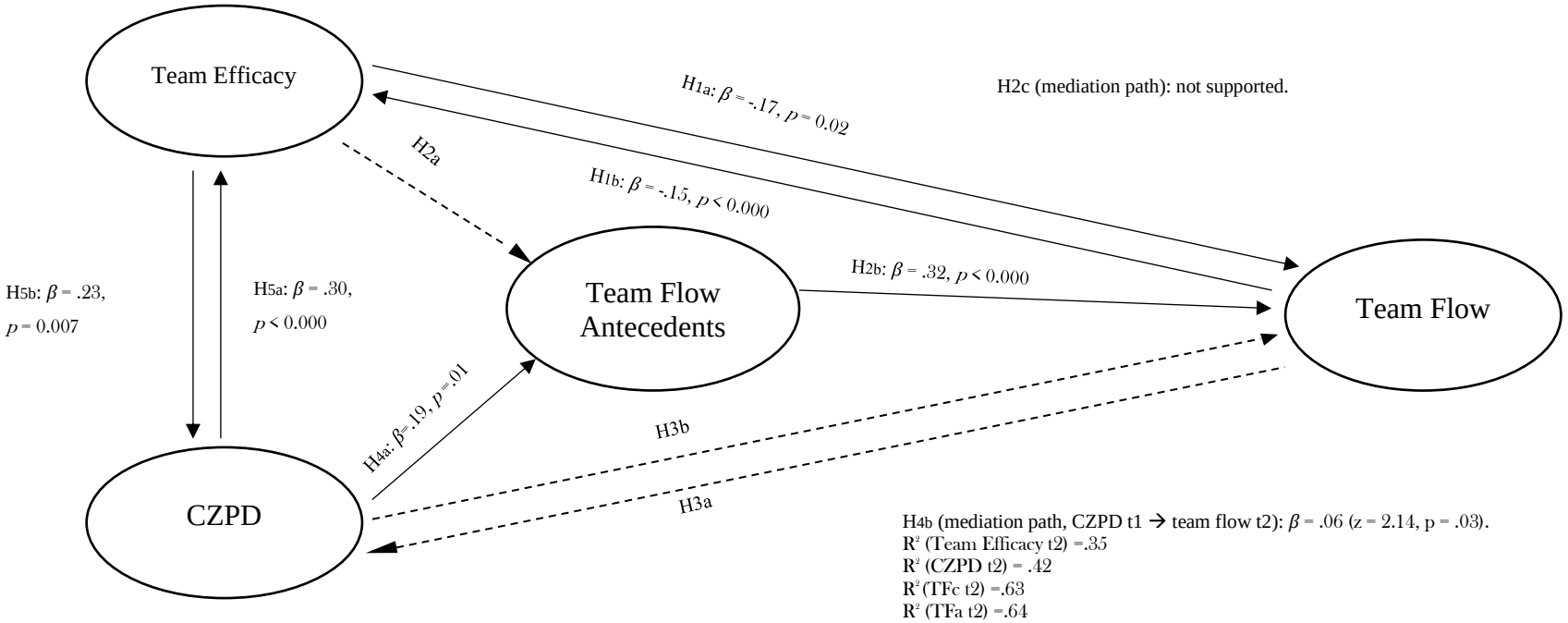


Figure 7- 3: The stylised PBrTF model with results.

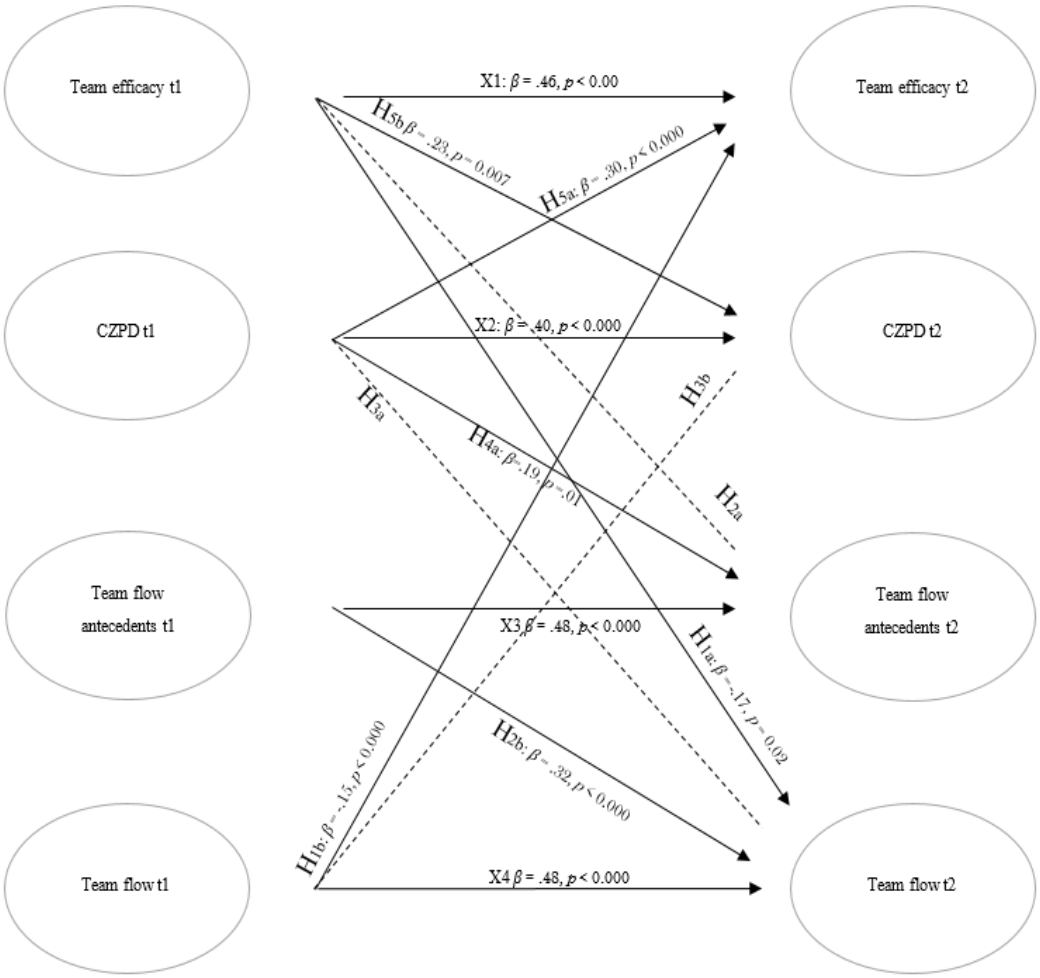


Figure 7- 4. The cross-lagged panel model of PBrTF with results.

7.2.4 Comparison of models and summary of Findings

As shown in Table 7-3, the χ^2 difference test indicates that there is not a significant discrepancy ($\Delta\chi^2$ (3) = 1.37) between the hypothesised model (M1) and the pruned model (M2). This result favours the most parsimonious model, which is the pruned model (M2). In summary, as illustrated in Figure 7-3, the pruned model shows that there are two reciprocal relationships. As hypothesised in H1a and H1b, team flow and team efficacy share a reciprocal relationship; however, this relationship is in the opposite direction than originally anticipated. Team efficacy and CZPD share a reciprocal relationship as hypothesised in H5a and H5b, and the direction of this relationship is positive, as expected. Failing to

support H3a and H3b, CZPD and team flow do not share any direct relationship (the dashed line in Figure 7-3 and 7-4). However, team flow antecedents mediate the causal relationship between CZPD and team flow, thus supporting H4a. Team flow antecedents, however, do not mediate the relationship between team efficacy and team flow, failing to support H2c. Contrary to H2a, team efficacy does not promote team flow antecedents (see dashed line in Figure 7-3 and 7-4). Overall, this model has accounted for 35% of the variance in Team Efficacy at T2 (R^2=.35), 42% of the variance in CZPD at T2 (R^2 = .42), 63% of the variance in TFc at T2 (R^2=.63), and 64% of the variance in TFa at T2 (R^2 =.64).

7. 3 Discussion

Based on social cognitive theory, this chapter aimed to test a proposed model of team flow, by exploring the dynamics of the feedback loops between team flow and its psychological and behavioural resources, namely team efficacy and the collaborative zone of proximal development. Specifically, the study sought to investigate whether building the teams' psychological resources of team efficacy and behavioural resources of CZPD would promote the experience of team flow, an enjoyable collective state of intense concentration that leads to optimal team performance and member wellbeing. Moreover, as is discussed in Chapter II, in light of the IMOI model of team effectiveness (Mathieu et al., 2008) and the Broaden and Build theory of positive psychology (Fredrickson, 2004), this study also examined how the experience of team flow replenishes and enriches a team's reservoir of the same resources, i.e. team efficacy and CZPD. Using longitudinal SEM, this study tested three pairs of reciprocal relationships and two mediation paths in this hypothesised model. As illustrated in Table 7-4, five research questions with eleven hypotheses were examined, the results of which are discussed in turn.

Table 7- 4: Research Findings

Research question No.	Hypotheses	Findings
1	(H1a) Team efficacy at the beginning (T1) of a team project positively predicts the perceived team flow at the end (T2) of a team project.	Partially supported
1	(H1b) Team flow at the beginning (T1) of a team project positively predicts perceived team efficacy at the end (T2) of a team project.	Partially supported
2	(H2a) Team efficacy at the beginning (T1) of a team project positively predicts flow antecedents at the end (T2) of the team project;	Not supported
2	(H2b) Team flow antecedents at the beginning (T1) of a team project positively predicts team flow at the end (T2) of the team project;	Supported
2	(H2c) Team flow antecedents mediate the relationship between team efficacy and team flow overtime (i.e. cross-time mediation path: H2a x H2b).	Not supported
3	(H3a) CZPD at the beginning (T1) of a team project positively predicts the perceived team flow at the end (T2) of the team project;	Not supported
3	(H3b) Team flow at the beginning (T1) of a team project positively predicts CZPD at the end (T2) of the team project.	Not supported
4	(H4a) CZPD at the beginning (T1) of a team project positively predicts the level of team flow antecedents at the end (T2) of the team project;	supported

4	(H4b) Team flow antecedents mediate the relationship between CZPD and team flow over time. (i.e. cross-time mediation path: H4a x H2b)	supported
5	(H5a) Team efficacy at the beginning (T1) of a team project positively predicts CZPD at the end (T2) of the team project;	supported
5	(H5b) CZPD at the beginning (T1) of a team project positively predicts the perceived team efficacy at the end (T2) of the team project.	supported

The results partially support the two hypotheses H1a and H1b, which are derived from research question 1. This research question looks into whether team flow and team efficacy share a positive reciprocal relationship. This reciprocal connection implies that teams that possess a higher level of task-specific confidence are more likely to experience team flow and more frequent experience of team flow further substantiates team members' efficacy beliefs in their teams. The results also demonstrated that there indeed is a reciprocal relationship between team efficacy and team flow; however, contrary to the expectation, this feedback loop is a negative one. Specifically, it was found that higher team efficacy beliefs at the beginning of the team project reduce the frequency of team flow experience at the end; and the more team flow is experienced at the beginning of the team project, the lower the team efficacy beliefs at the end of the team project.

In terms of the association between team efficacy and team flow, this result coincides with the broad speculation put forward by Social Cognitive Theory (SCT; Bandura, 1977), which posits that personal belief influences people's perception of their environment and vice versa. In this case of this study, team efficacy, as a type of self-evaluation of a project team's competency can be regarded as representing the belief of a collective competency, which shares a mutually influential relationship with team flow, a collective state of mind shaping the team environment. However, the direction of this association does not concur with the findings of Salanova et al. (2014), and is somewhat counterintuitive at first glance. Based on the framework of the Broaden and Build theory of positive

emotions (Fredrickson, 2004), team flow and team efficacy are expected to be mutually perpetuating. Specifically, on the one hand, the optimal performance experience of team flow brings about the positive emotion of enjoyment and broadens team members' awareness through a sense of accomplishment and vicarious experience. Both of these are the most potent sources for positive evaluation of a team's task-specific capability (Bandura, 2000). On the other hand, team efficacy, as a psychological resource that boosts a team's confidence in their ability to deal with the demands presented to the team, should work to build and maintain a sense of balance between the challenges and the team's competency. This sense of balance leads to the emergence of team flow, an intense collective state of concentration. It was therefore expected that a positive spiral between team flow and team efficacy would form.

However, the counterintuitive finding of a negative spiral is not entirely unreasonable. As discussed in Chapter II, team efficacy does not always lead to increased performance. Based on Rapp et al., (2014) discussion on the too-much-of-a-good-thing effect, overconfidence breeds a sense of complacency. Instead of motivating a team to initiate task-related actions and work towards the attainment of the team's goals, overly high levels of team efficacy can result in a lack of willingness to invest effort and energy, and therefore, discourage engagement. In other words, similar to outcome expectations, high collective efficacy nurtures a reluctance to concentrate on and engage in a task. Therefore, it is speculated that overconfident teams are convinced that their ability exceeds the challenge presented to them and therefore find it difficult to experience the motivation and absorption characteristics of team flow. Indeed, according to the Channel Model of Flow (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009), people tend to feel bored when the activity does not provide enough challenge, and eventually, lose interest in it all together. The previous discussion in Chapter II mentioned that flow, as an intense experience of concentration, is the result of a sense of balance between skill and challenge. Higher frequency and intensity of flow means that an individual or a team is constantly subjected to a level of challenge or demand that they can just about to manage. In other words, the skill-challenge balance inducing the flow experience is attention-seizing because of the perception of being "on edge". Although this state of mind promotes active

learning and skill acquisition, it will nevertheless generate feelings of a struggle, especially before mastering a higher level of complexity. Like the two forms of flow found in study 1 Chapter IV, according to the participants, team flow presents in two forms, namely the synchronised form, which represents a harmonious and cohesive state, and the frictional from, which represents intensive idea clashing and exchange. In a frictional state, as the focus is to generate diversified ideas to aid problem solving, the members have to work through disagreements, which although still result in concentration and high performance, the process was not enjoyable. It was a struggle which does not do much in helping increase the member's perception of collective competence. It is expected that the same might apply to the teams in the current participants. As the participating teams in this study were assembled to finish a course work, they were confronted with problems that was beyond their collective ability. Until their team projects were done, it is understandable that they might not be very confident about their performance especially if they had been exposed to more frictional form of team flow. Thus, a mutually negative relationship were formed between team efficacy and team flow.

Research question 2 aims to enquire if team efficacy leads to team flow via its influence on team flow antecedents. The results supported H2b but failed to support H2a and H2c. First, the findings of H2b will be discussed. H2b hypothesised that team flow antecedents positively predict team flow experience. Team flow was measured using the adapted team version of the WOLF questionnaire (Bakkar, 2005; 2008), which only tests the core experience of flow in terms of absorption, enjoyment and motivation. The researcher, therefore, added a team flow antecedents questionnaire. Flow antecedents comprise three aspects: the evaluation of the balance between skill and challenge, goal clarity, and feedback clarity. The flow antecedents items are from Quinn's (2015) questionnaire, which is adapted from the FSS (Jackson & Marsh, 1996) for knowledge workers. As discussed on multiple occasions throughout this thesis, a perceived balance between skill and challenge is a key precursor to the flow experience. Moreover, according to Csikszentmihalyi's original nine-dimensional framework of flow, a clear goal and immediate feedback of performance are also essential conditions to flow experience. A clear goal is necessary to focus people's attention on the task and feedback helps track performance and make adjustments.

As is found in study 3, the team flow antecedents scale is unidimensional, and encapsulates the three key aspects of the latent constructs of flow antecedents that characterise the pre-conditions for flow. The finding of H2b agrees with Csikszentmihalyi's nine-dimensional framework and the findings from Bakker(2008), Tenenbaum et al., (1999) and Quinn (2005).

The results failed to support H2a. According to Hayes (2018), the result also failed to support the mediation hypothesis of H2c on the basis that a statistically significant path (H2a in this case) is the first step to establishing a mediation model. This result indicated that team efficacy at the beginning of a team project did not predict team flow antecedents, and therefore, team flow antecedents do not convey team efficacy's influence on team flow. This result is not in line with Salanova et al. (2014), which finds that team efficacy positively predicts the balance between skill and challenge. It is possible that because the balance between skill and challenge is only one of the three key antecedents of team flow, therefore when adding clear goal and feedback to form a combined effect, team efficacy is no longer a strong predictor. A possible explanation is that although confidence beliefs might motivate the activities of task planning and providing feedback at the beginning of a team project, it does not have a long-lasting effect. In other words, team efficacy does not affect goal clarity and feedback clarity.

Research question 3 asks whether there is a reciprocal relationship between CZPD and team flow. Again, this hypothesis was based on the SCT framework, where CZPD is seen as the behavioural aspect that influences the environment aspect of team flow. Contrary to this proposition, neither H3a nor H3b were supported, which indicates that CZPD at the beginning of the team project does not directly predict team flow at the end and that the team flow experience at the beginning of the team project does not predict CZPD at the end of the project. In other words, CZPD and team flow do not share a mutually beneficial relationship. However, this is not the full story because in research question 4, the researcher hypothesised a potential mediational role of team flow antecedents on the causal relationship between CZPD and team flow. The results

support H4a, indicating that CZPD positively predicts team flow antecedents. Considering that team flow antecedents were found to positively predict team flow (H2b), and the result suggested that this indirect path was statistically significant, H4b is thus supported. These results suggests that CZPD exerts its influence on team flow not directly, but via its effect on team flow antecedents. In other words, team flow antecedents fully mediate the casual relationship between CZPD and team flow. Therefore, this result partially supported H3a.

The above result supports the argument presented in Chapter II, which postulates that CZPD promotes team flow by nurturing its three antecedents (H4a). As a characteristic of a peer-learning self-organising system, CZPD serves as a breeding ground for idea interaction. CZPD enables a team to exploit the reservoir of diversity and redundancy and strive to quickly acquire the appropriate knowledge to restore a new balance between challenge and skills. Moreover, as a team in CZPD is task centred, it places the task goal at its core, so members always have a clear picture of it. The idea interaction process in CZPD ensures that members keep track of the performance of the individuals and the team as a whole, and adjust accordingly and immediately.

The above results support the suggestion of Broaden and Build theory (Fredrickson, 2004) in that CZPD is the breeding ground for collective skill development which serves as the team's resources and enhances its sense of competency and fulfilment, i.e. team flow, through its influence on flow antecedents (H4b). Also, as the positive effect spirals on, flow, in turn, would enhance the CZPD. However, contrary to the prediction, team flow does not reinforce CZPD (H3b). It was postulated that because flow acts as a psychic compass which directs the psychological selection process to choose activities that reinforce the repeated occurrence of flow, team flow should motivate teams to follow the same social structure. For example, intrinsic motivation of flow should encourage continuous improvement and learning, which drives members to give suggestions and opinions that promote an exchange and integration of ideas. Absorption guides members to place the centre of control to the goal of the task. However, as the results from study 2 and study 3 showed, CZPD is a unidimensional latent concept, it is a phenomenon that relies on the integration

of its five aspects. In other words, changing an individual element in CZPD would not suffice. Indeed, a key feature of CZPD is the team's ability to constantly adjust and find an appropriate configuration of diversity and redundancy under different circumstances. Moreover, as the internal and external environment of a team is constantly changing, a team operating in CZPD would not have a fixed structure. Therefore, this explains why team flow as a psychic compass fails to predict CZPD, which is dynamic and continuously evolving.

The results also support H5a and H5b, which indicates that there is indeed a reciprocal relationship between CZPD and team efficacy. Specifically, this reciprocal relationship suggests that a higher level of team efficacy at the beginning of the team project positively predicts the CZPD at the end of the team project. In turn, a higher level of CZPD at the beginning of a team project promotes team efficacy at the end of the team project. This finding concurs with the SCT framework, where CZPD is considered as the behavioural aspect that influences and influenced by the personal or social aspects of team efficacy. As is theorised in Chapter II, the ongoing exchange between members' core skills and the learning potential or zone of proximal development of another member is the source of mastery experience and opportunity for modelling, which are two primary sources for the development and improvement of efficacy beliefs. Higher team efficacy, conversely, promotes a sense of mutual trust in terms of members' ability and accountability. This confidence encourages team members to explore the boundary of the team's potential rooted in the asymmetry of members' expertise and make the most of it under the constraints of the internal and external demands, thus also reinforcing the proposition of Broaden and Build theory (Fredrickson, 2004).

7.4 Chapter summary

In this last study of this thesis, the proposed PBrTF model was tested using longitudinal SEM. To bypass the risk of overdimensionalisation of CFA, the measurement model portion of this model was built by splicing the IRT models into SEM. The results show that, in line with the SCT and the Broaden and Build

theory, the psychological and behavioural resources team efficacy and CZPD share a mutually reinforcing relationship. In addition, team efficacy and team flow were found to share a reciprocal relationship as SCT framework suggested, however, contrary to the Broaden and Build theory, this relationship between these two supposedly positive constructs was mutually undermining. The results also indicate that CZPD and team flow do not share a mutually reinforcing relationship. The findings suggest the effect of CZPD to team flow is mediated by team flow antecedents. However, team flow was not found to be the mediator between team efficacy and team flow. Therefore the results partially support the proposed PBrTF model.

CHAPTER VIII: CONCLUSION AND FUTURE DIRECTIONS

8 Overview

In this chapter, the objectives of the project and the main findings of the empirical studies will be discussed together with a careful reflection on the strengths and limitations of the research. This chapter ends drawing on conclusions of the project and suggests potential areas for future research.

8.1 The research objectives

The underlying driving force of this thesis is to develop a tool to help enhance team effectiveness. Based on the premises of the Social Cognitive Theory (SCT: Bandura, 1986) and the Broaden and Build theory of positive emotions (Fredrickson, 2004), the purpose of this research was to develop and test the psychological and behavioural resources model of team flow (PBrTF), which could assist to develop an effective team. To achieve this, this project outlined four overall objectives. These were (1) as CZPD is a relatively new construct, the first objective was to explore and further develop its conceptualisation and relationship with team efficacy and team flow. (2) based on the more concreate understand of CZPD after achieving objective 1, develop a questionnaire to operationalise CZPD. (3) to validate the new CZPD questionnaire by testing its dimensional validity and measurement stability. (4) to test the proposed PBrTF model using this new CZPD questionnaire togather with the established team efficacy and team flow questionnaires. The following four sections present the key findings and messages from the four studies.

8.1.1 CZPD and its association with team flow and team efficacy (Study 1): key findings

Research on team collaboration and team effectiveness has seen steady development. In order to understand the nature of teamwork, scholars have developed a variety of models conceptualising teams' performance from different perspectives, for example, the IMOI team effectiveness framework (Mathieu et al., 2008), the team lifecycle models (Kozlowski et al., 1999) and multilevel theory of the emergence of team level phenomena. These frameworks are all regarded as metaphorical discourses that help researchers establish the groundwork for the conceptualisation and operationalisation of new constructs. Based on these frameworks, this research sought to identify the structure of team interactions that contribute to the emergence of team flow, or put simply, the behavioural resources for team flow based on Bandura's (1986) social cognitive theory.

The main objective of study 1 was twofold: (1) to further develop the conceptualisation of the relatively new and less researched construct of CZPD and explore its relationship with team efficacy and team flow; (2) based on the more concreate understand of CZPD after achieving objective 1, develop a questionnaire to operationalise CZPD. To achieve these objectives, study 1 has employed semi-structured interviews, this study explored participants' perceptions of their own team collaboration processes in terms of the five aspects of a self-organising learning system proposed by David and Simmt (2003). The interviews focused on exploring participants' experiences of their team's organising structure and the frequency and manner of communication. Moreover, in order to establish a preliminary picture of the relationships between CZPD, team efficacy and team flow, this study also explored participants' perceptions of how these constructs interact and influence one another. Below is a summary of the key findings and messages of this study:

- Research question 1: *How do teams organise their interactions in terms of the five characteristics of CZPD, namely idea interaction, decentralised control, diversity, redundancy, and organised randomness*?

  The results support the propositions of Davis and Simmt (2003), demonstrating that these five conditions all contribute to the emergence of a self-organising system. Moreover, the results also suggest that more often

than not, teams reach optimal performance as a result of the interaction of the five conditions. This implies that theoretically speaking, CZPD could be seen either as a construct comprised of five independent aspects, or a construct resulting from the interaction of these five aspects.

- Research question 2: *Does a team's CZPD have an association with the emergence of team efficacy and team flow*?

  The evidence also suggests that team flow, team efficacy and CZPD share a reciprocal relationship. When participants described a CPZD-like interaction, they also expressed elevated team efficacy and experience of team flow.

These findings have important theoretical and practical implications. First, building on the disucssed, Study 1 offered a unique contribution to the existing literature on CZPD by refining and developing the theorisation and operationalisation of the construct. This research has arguably addressed the gap in the literature that all previous research studies on the effectiveness of self-organising project teams have so far overlooked. The previous research has focussed solely on the education sector and the classroom behaviours of students. However, the five conditions proposed by Davis and Simmit (2003) was actually based on the observation of a self-organising collective comprised teachers—adults in an occupational setting. In short, the theorisation of CZPD in this thesis was occupationally orientated to start with. Another gap is that previous researchers have mainly focused on investigating the communication structures of teams with the exception of Armstrong (2008). The improvement in this study is that the five conditions of CZPD investigated have also focused on the structure of team skill and knowledge composition, i.e. diversity and redundancy. This improvement was made possible because, in contrast to previous studies, this research has based the theorisation of CZPD on a rich literature such as team compilation, Multilevel Theory, and Complexity Theory and group flow theories (see Chapter II for details during its development). In addition, the fifth aspect of CZPD, organised randomness, points to the collective level competency of adaptability which relates closely to Sawyer's (2003) notion of the relationship between pre-existing

structures and group flow. As discussed in Chapter II, Sawyer suggests four structures which are similar to the redundancy aspect of CZPD and contends that in order for group flow to emerge, a team or collective needs to be able to adjust the number of shared structures in accordance with the requirement of the team goal. This theorisation coincides with organised randomness which suggests that a team will be able to experience team flow when it can achieve a sense of balance along the continuum of diversity and redundancy. Therefore, this study has advanced the theorisation of CZPD by re-orienting the concept to the occupational setting, focussing on wider conditions including the interaction structure, skill and knowledge configuration and the adaptability of the team as a whole.

Second, the findings of study 1 also advance the theorisation of CZPD by questioning the composition of this concept. In Davis and Simmit's (2003) original description, CZPD, or the conditions of a self-organising system, are composed of five distinct features, namely, neighbour interaction, decentralised control, diversity, redundancy and organised randomness. Although the findings supported this proposition, it also demonstrated that the five conditions do not appear during team collaboration separately. In fact, according to participants descriptions, teamwork processes always involve more than one of these five conditions. When participants reported team flow-like experiences during team collaboration, more often than not, all five conditions appear and interact with one another in order for the team to deliver successful performance. This observation suggests that CZPD could be a single-dimensional construct encompassing five aspects which pertain to a team's performance in terms of its communication pattern, collective skills configuration and team level adaptability. The findings raise an interesting question regarding CZPD's construct dimensionality, which is an important property as it influences not only the conceptualisation of the concept but also the accuracy of the results and interpretation of findings. Based on these findings, a CZPD questionnaire with a 43-item pool was developed and subsequently tested.

The third contribution of the findings from study 1 is that it has improved on previous work and added to our understanding of team flow. According to the

literature, team flow is similar to its individual-level counterpart and that the experience of team flow or group flow, brings about positive feelings in team members including enjoyment, absorption and intrinsic motivation (Armstrong, 2008; Bakker, 2005, 2008; Salanova et al., 2006; Salanova, et al., 2014; Sawyer & Dezutter, 2009). However, the findings in study 1 suggest that team flow has two main forms, one is termed as synchronised flow, which is considered as an enjoyable form of team flow that promotes cohesion and knowledge convergence and supported by the existing literature on flow. However, in addition to this enjoyable aspect of team flow, the findings also suggest another form of team flow, which is termed as frictional flow. This type of team flow appeared as teams focused on product innovation and the divergence of skill and knowledge base. As the goal of this stage was to voice out as many ideas as possible and promote competing ideas for the sake of creativity, members reported experiencing more negative thoughts and feelings and described that their teams were in a state of struggle. Nevertheless, during either form of team flow, participants reported a high level of collective concentration and motivation. These findings provide support to previous studies but at the same time, raise questions about the emotional component of team flow. Why an optimal state of collective performance might not necessarily bring about positive feelings such as enjoyment, warrants further investigation of the emotional reactions of team flow.

The fourth contribution of the findings from study 1 is that it provided the first empirical, albeit, preliminary support for the PBrTF model. As the discussion in Chapter II suggested, the PBrTF model proposes a triadic and reciprocal relationship between the three main variables of CZPD, team efficacy and team flow. As the findings illustrated, in the participants' description, while CZPD like collaborations present, the participants often also report a team flow like experience including intense absorption, enjoyment and motivation. The participants also reported moments like these made them more confident in their teams' ability to perform well. Although previous studies such as Salanova et al (2014) has tested and supported the relationship between team efficacy and team flow, the result of this study, however, has built up on Salanova and colleagues (2014) and suggested the contribution of CZPD as a behavioural resource of team

flow as well. Based on these findings, a 43 item pool was developed as a way to operationlise CZPD (Chapter III has detailed the development process).

In summary, study 1 has achieved the first two objectives of this research by refining, further developing and operationalising the concept of CZPD. Building on the literature of team effectiveness, team lifecycles, multilevel theory and the conditions of self-organising systems, this study provides the first empirical evidence supporting the proposition of the five conditions for the emergence of self-organising learning system or CZPD based on Davis and Simmt (2004). As a result of this work, a 43-item pool was developed to build the CZPD questionnaire. Also, the results suggested that team flow might have two forms and that its accompanying emotional reactions might not always be positive. Moreover, the results also serve as the first empirical evidence to support the BPrTF model. Next, the discussion turns to the key findings of study 2.

8.1.2 Scalability and internal consistency of CZPD – a pilot study: key findings

Study 2 was designed to achieve the first part of objective three. Building on the findings from study 1, study 2 aimed to test the scalability and internal consistency of CZPD using the 43-item pool developed as a result of study 1. Study 1 suggested that CZPD could either be a construct with five distinct aspects or a single-dimensional concept with five elements interacting to form one dimension. As a result of this uncertainty, the item pool was subjected to Mokken Scale Analysis (MSA) to test for item scalability and scale dimensionality. An ordinal measurement model based on the theoretical rationale of the Item Response Theory (IRT), MSA was considered a more appropriate analytical method compared to factor analysis because factor analysis often contributes to the over-dimensionalisation of Likert-scale items (Mokken, 2011; Sijtsman & Molenaar, 2002; van Schuur, 2011). Moreover, on top of dimensionality, MSA also tests whether CZPD satisfies the assumptions of the monotone homogeneity model (MHM), which is another important psychometric property that justifies the practice of ranking a respondent on a latent trait using his/her total score on a unidimensional scale (Sijtsma & Meijer, 2007; Sijtsma & Molenaar, 2002). Taken

together, study 2 aimed to examine whether CZPD is a single-dimensional construct and whether it can validly rank-order respondents on this latent dimension. Following is a summary of the key findings and messages of this study:

Research question 1: Do the items in the CZPD pilot questionnaire reflect a single-dimensional latent structure or multiple dimensions?

The results suggest that CZPD is a single-dimensional construct with 16 items tapping into all five conditions of a self-organised system as proposed by Davis & Simmt, (2003). The 16 items are considered to have low scalability and form a weak to medium level single-dimensional scale. This result is also supported by the fact that the remaining 27 items have not formed any meaningful pattern and are therefore considered redundant. The scale has a satisfactory level of internal consistency.

Research question 2: Does the CZPD pilot questionnaire have a monotone hierarchical structure?

The results also suggest that the 16-item CZPD questionnaire satisfies the assumption of MHM, which implies that users of CZPD questionnaire can rank participants on this latent construct using their total score of CZPD by aggregating individual item-scores.

These results have important theoretical and practical implications for the scale of CZPD. The results from study 1 pointed out that there is uncertainty over the dimensionality of CZPD. The literature suggests that CZPD has five aspects; however, the findings in study 1 demonstrated that these five aspects are closely correlated and often interact. Using Mokken Scale Analysis, the findings in study 2 has provided preliminary evidence supporting the single-dimensional hypothesis. Theoretically speaking, these results advance the conceptualisation of CZPD by clarifying the conceptual structure of CZPD and facilitating the interpretation of the phenomenon of a self-organising system. As per the literature, the aspects of idea interaction and decentralised control in CZPD are considered to be the interaction structure of a team, while diversity and redundancy are considered to

be the skill and knowledge composition of a team. Organised randomness as the fifth aspect of CZPD is the team's ability to balance itself between diversity and redundancy based on the contextual circumstances. Based on the preliminary findings, CZPD can be defined as the social breeding ground for an effective peer-learning system that is "smart" enough to learn and adapt its internal skill composition to the external demands. The latter is consistent with thinking by Sawyer (2007), who speculated that a team's peak performance is underpinned by its collective ability to adjust the number of shared structures in accordance to the changing task nature. Therefore, the results suggest that, as a unidimensional construct, CZPD describes a meso-level adaptability of a team that only emerges as a result of member interaction. In other words, a team that is high on CZPD is more capable of utilising its collective level skills to solve a problem.

Practically speaking, as a MHM model, the 16-item CZPD scale can be used to rank teams on their unit-level competency. In other words, a team scoring higher on CZPD is considered to be better at problem-solving through a peer-learning process. Although the findings are preliminary and further research and new samples are needed to test the scale, it nevertheless serves as initial validity evidence for CZPD. Moreover, as the research has employed MSA, which is considered a technique more suitable for examining the scalability of Likert-scale items, the results are more robust and trustworthy and offer a relatively more reliable basis for further studies. This study also tested the MHM assumption which further supports that the 16-item CZPD scale can be used to order teams on this latent construct (Sijtsma & Meijer, 2007; Sijtsma & Molenaar, 2002).

In summary, study 2 has achieved the first part of the research objective by pilot testing the CZPD questionnaire developed by the end of study 1. Study 2 has provided initial evidence supporting the single-dimension conceptualisation of CZPD. Also, the resulting 16-item CZPD scale can be used in further studies to verify its item scalability and scale dimensionality.

8.1.3 Dimensionality and dimensional stability of the measures (study 3): Key findings

Study 3 was designed to achieve the second part of the research objective three. The findings from study 2 demonstrated that CZPD is a unidimensional construct and that the 16-item scale of CZPD satisfies the MHM assumption. However, as these results are only preliminary and based on a single sample, more evidence is needed to support these findings. As a result, this study aimed to explore the dimensional stability of the scales of CZPD, team efficacy, team flow antecedents and team flow core experience, which are key study variables used to test the PBrTF model. Using MSA, this study examined the key variables' dimensional stability by testing for inter-individual differences, intra-individual differences and intra-individual changes proposed by Buss (1974). The MHM assumption is also tested as part of the investigation.

The research questions and the key messages of the findings are as follows:

R1: *Does the collective efficacy questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

The findings demonstrate that, across the time lag, perceived collective efficacy scale (CE) showed a stable single-dimensional structure. MSA shows that it satisfied a monotonic hierarchical dimensionality with good internal consistency.

R2: *Does the CZPD questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

The findings demonstrated that, across the time lag, 12 items out of the 16 items of CZPD scale showed a stable single-dimensional structure and that it satisfied a monotonic hierarchical dimensionality with good internal consistency.

R3: *Does the team flow antecedents questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

The findings demonstrated that, across the time lag, the team flow antecedents (TFa) scale showed a stable single-dimensional structure and that it satisfied a monotonic hierarchical dimensionality with good internal consistency.

R4: *Does he team flow questionnaire demonstrate stability in its monotonic hierarchical dimensionality from T1 to T2?*

The findings demonstrated that, across the time lag, 11 items out of the 13 items of the team flow core experience (TFc) scale showed a stable single-dimensional structure and that it satisfied a monotonic hierarchical dimensionality with good internal consistency.

The findings in study four have important theoretical and practical implications. For CZPD, using the 16-item version developed in study 3, provides further evidence supporting the claim that CZPD is a single-dimensional structure. Using a different set of data from study 2, CZPD was found to have a stable single-dimensional structure across the time lag. The latter further supports the theorisation that CZPD, which is characteristic of an effective self-organising project team, is a collective competency that emerges as a result of the interaction between its five aspects. However, four items, *ii1*, *ii6*, *dc13* and *or 43*, showed instability across the time lag. As the discussion in section 6.3 pointed out, because item *dc13* has failed to scale at both times, it is possible that the participants from study 2 and study 3 have understood this item differently. In other words, this could be a result of sample difference. Therefore, although this item was removed from study 4, it should be included in future studies with different participants. The other three items *ii1*, *ii6* and *or43*, were also removed from study 4 because they were only scaled in CZPD at time 2. The findings suggested that the items were influenced by intraindividual changes in that these items were perceived differently by the same teams at the end of their team projects compared to when they first started (see detailed discussion in section 6.3). Apart from CZPD, the TFc scale also has two items demonstrating dimensional instability across time. As is discussed in section 6.3, this instability in these two items is also considered to be a result of the influence of intraindividual changes. Future research on the

stability of these three items across time lag is warranted in order to provide further evidence on the suitability of these items for both the CZPD and TFc scale.

Theoretically speaking, the aforementioned unstable items might indicate that CZPD and team flow have not fully emerged at the time of the time 1 questionnaire administration. In other words, the emergence of CZPD and TFc is the result of an effective team collaboration which is only possible in teams achieved team compilation (Kozlowski & Bell, 2013). The intra-individual changes represent the differences in the perceptions of the members as a result of participating in effective project teams. Practically speaking, the findings also suggest that future studies should attempt to investigate the item stability by collecting data at more than two time points. This way, the analysis could demonstrate when the changes have occurred in terms of members' perceptions. No dimensional instability was found in in the Perceived Collective Efficacy Scale (CE) and the Team Flow antecedents (TFa) scale. Following the same logic, the stability in the two scales show that intra-individual changes have not had any significant impact on participants' perceptions of the items in these two scales. Therefore, from a conceptual point of view, it might be interpreted as that members were able to look at the same sources of team efficacy across time to evaluate the teams' collective competency. In other words, the four sources of efficacy beliefs, namely mastery experience, vicarious learning, verbal persuasion and physiological states (Bandura, 2000) have all become available since the inception of teamwork. The same might apply to TFa as well, the perception of the balance between skill and challenge, goal clarity and immediate feedback have all established soon after the team is assembled.

Also interesting is that, although not part of the hypotheses in study 3, the results contradict the literature in that TFa and TFc were both found to be unidimensional. The original Team Flow Core experience scale, WOLF, has three sub-dimensions, namely *absorption*, *enjoyment* and *intrinsic motivation* (Bakker 2005, 2008). The original Team Flow Antecedents scale (TFa), FSS (Tenenbaum et al., 1999), also has three sub-dimensions, namely *balance between skill and challenge*, *goal clarity* and *immediate feedback*. The contradictory findings might be explained using the discussion of van der Eijk and Rose (2015),

which has demonstrated that factor analysis tends to over-dimensionalise scales using Likert-scale items. van der Eijk & Rose (2015) claim that over-dimensionalisation could result in unjustifiable conceptual distinctions which damage the reliability and comparability of a construct. In effect, the findings had a significant influence on the analysis of the final study in that, instead of using the subscales, the researcher was able to use the total scores of each scale to characterise the participants. Also, in terms of conceptualisation, TFc and TFa can be seen as single-dimensional constructs comprising the aspects that were all part of the original conceptualisation. Specifically, for TFc, although Bakker (2005; 2008) proposed a three-dimensional structure including absorption, enjoyment and intrinsic motivation, the following studies (Salanova et al., 2003) have shown evidence to suggest that intrinsic motivation does not belong to the core of workplace flow experience. As a result, a follow-up study (Salanova et al., 2014) did not use the intrinsic motivation dimension. This debate over the dimensionality of WOLF (the original of TFc) has a profound impact on the conceptualisation and operationalisation of workplace flow, which could actually be the result of the artefact of factor analysis. The same goes for TFa. The original Channel Model of Flow emphasises the importance of the perceived balance between skill and challenge in inducing the flow experience (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009). However, the nine-dimensional model of flow also proposed that apart from the balance between skill and challenge, goal clarity and immediate feedback are also important antecedents for the flow experience as has been demonstrated in many studies, for example, Quinn, 2005 and Tenenbaum et al. 1999. However, as results from the factor analysis suggest that the three dimensions are distinct sub-dimensions, research has been using these three team flow antecedents as separate dimensions, more often than not, they only used the dimension of balance between skill and challenge as the only indicator of flow antecedent. This practice has obviously artificially narrowed the width of the concept of flow antecedents.

In summary, Study 3 has achieved the research objective three and the results have provided important evidence of dimensional stabilities of the four scales, namely TFc, TFa, CZPD and CE. This information has helped clarify and develop the conceptualisation of the individual constructs. Moreover, by

identifying unstable items from TFc and CZPD, study 3 also provided a strong basis for the use of longitudinal structural equation modelling in study 4.

8.1.4 Testing the hypothesised psychological and behavioural resources model of team flow (PBrTF): Key findings

In study 3, the dimensional invariance of all four key measures was tested using Mokken Scale Analysis (MSA). Building on the findings, the objective of study 4 was to test the proposed PBrTF model using a longitudinal SEM design. A summary of the key findings is summarised below:

Research question 1: Do team flow and team efficacy have a positive reciprocal relationship, i.e. in that teams that possess a higher level of task-specific confidence are more likely to experience team flow and vice versa?

The results showed that team efficacy and team flow share a reciprocal relationship over time. In other words, team efficacy at the beginning of a team project predicts team flow at the end and vice versa. However, this relationship is not a mutually reinforcing one. The increase in team efficacy at the beginning of a team project predicts a decrease of team flow at the end and an increase of team flow experience at the beginning results in a decrease in team efficacy at the end of a project.

Research question 2: Does team efficacy promote the experience of team flow through its positive effect on team flow antecedents?

The findings suggest that there is not an indirect relationship between team efficacy and team flow. This is because, team efficacy at the beginning of the team project does not predict team flow antecedents at the end. Team flow antecedents are found to predict team flow across the time lag.

Research question 3: Do team flow and CZPD have a positive reciprocal relationship, i.e. in that teams with a higher level of CZPD are more likely to experience team flow and vice versa?

The findings suggest that team flow and CZPD do not have a mutually reinforcing relationship over time. CZPD at the beginning of a team project did not predict team flow at the end and team flow at the beginning of a team project did not predict CZPD at the end of the project.

Research question 4: Does CZPD promote the experience of team flow through its positive effect on team flow antecedents?

The findings suggest that, although no direct relationships were found between CZPD and team flow, their relationship was completely mediated by team flow antecedents over time.

Research question 5: Do CZPD and team efficacy have a positive reciprocal relationship, i.e. in that teams possess a higher level of task-specific confidence would have a higher level of CZPD and vice versa?

CZPD and team efficacy were found to share a mutually reinforcing relationship over time. Specifically, an increase in CZPD at the beginning of a team project results in an increase in team efficacy at the end of a team project; and an increase in team efficacy at the beginning of a team project also leads to an increase in CZPD at the end.

The results for research question 1 encourage a rethinking of the nature of these two constructs. As discussed in Chapter II, efficacy beliefs normally lead to a positive evaluation of someone's task-specific competence, which boosts motivation to initiate action and sustains perseverance. As predicted, the findings in relation to research question 5 support this theorisation by demonstrating that

team efficacy predicts CZPD. In other words, a higher level of team efficacy motivates members to frequently exchange and interact with each other's ideas, put their project task at the centre of attention, contribute diversified input and adopt teamworking skills and conventions quickly. However, Rapp et al. (2014) research suggests that team efficacy actually shares a curvilinear relationship with performance. Specifically, teams that have scored either too high or too low on the team efficacy scale are found to exhibit decreased performance. In other words, only a moderate level of team efficacy help increase performance. Pierce and Aguinis (2011) termed this finding as the "*too much of a good thing*" phenomenon. They postulated that the reason why high levels of team efficacy can lead to decreased performance is that overconfidence could result in a sense of complacency. A team with members who believe that their task is easy might not be motivated to focus on the task. They might choose to prioritise other matters and thus fail to deliver results. For team flow, such complacency could demotivate members from engaging in and concentrating on the task. Thus, high levels of team efficacy can actually hinder the emergence of team flow or suppresses the magnitude of team flow experience in a team. An alternative explanation for this finding could be that, as the survey was only administered twice, i.e. at the beginning and end of the team project, it is possible that in so doing, the researcher has failed to capture the fluctuations in both of these two emergent phenomena. For example, it is possible that, at the beginning of the team project, members who shared a disbelief in their team's task-related capability actually invested more to improve their skills and knowledge. Because this fear of failure, members were driven to work more on the project and as a result experienced more team flow at the end of the project due to increased internal motivation and absorption. However, this interpretation is less likely because, as explained by Bandura (1977; 2006), efficacy improves performance and effectiveness as it helps initiate action and sustains perseverance. In other words, this alternative interpretation is less likely because it goes against the core conceptualisation of efficacy beliefs.

The findings also question the current conceptualisation of the nature of team flow. As is discussed in Chapter II and study 3, the team flow questionnaire used in study 4 is adapted from Bakker (2005, 2008), which proposes that the

core of a flow experience has three features: absorption, enjoyment and intrinsic motivation. It is therefore reasonable to assume that the experience of flow should elicit a positive emotional response. As discussed in Chapter II, the peak performance experience of flow can be addictive and act as a psychic compass that drives people to repeat the actions that lead to flow. However, the results from study 1 have illustrated that the peak performance experience of team flow might actually be two-sided. On the one hand, the experience of team flow can be positive and enjoyable as documented in the literature. The findings from study 1 suggest that this type of team flow experience is cohesive and based on consensus. For example, participants reported such a type of flow emerged while their team was delivering a presentation. The experience was enjoyable because the members have become a synchronised unit wherein members' coordination was seamless. However, on the other hand, team flow can be an experience where there is a friction between members. This type of flow often occurs when the team is engaged in a discussion that is focussed on innovation and creativity. Because a team is trying to exploit the diversity of members' skills and knowledge, disagreement and misunderstandings often occur. Although the team is still focused, this process can be frustrating. As a result, the emotional response evoked by team flow is not always positive. Moreover, as discussed in Chapter II, for a team to experience team flow continuously means that the team is constantly subjected to challenges that test the team's optimal level of ability. In other words, the team is always on "edge". Once the team has acquired the level of skill needed to tackle the challenge, the activity ceases to be as absorbing and the team is no longer in flow. As a result, it is understandable why a high level of team flow decreases members' efficacy levels as they have yet to master the necessary skills to accomplish the task or activity.

Taken together, the above arguments have explained that based on the findings in this research and the literature, the conceptualisation of team flow and team efficacy requires a new perspective. These two constructs have always been regarded as positive, facilitating the flourishing of individuals in the workplace. However, this perception might be too narrow and the functions of these two constructs are far more complex than they seem, for example, a simple linear relationship might not be enough to summarise the nature of their association. In

terms of application, the findings caution against making the assumption that team flow and team efficacy only elicit positive effects. Based on the above discussion, it is possible that team efficacy only promotes team effectiveness within a moderate range of magnitude and that team flow is only enjoyable and enhances team efficacy when the team is synchronous.

Also contrary to the prediction of PBrTF is that, although CZPD is found to predict team flow via the mediational influence of team flow antecedents over time, the results to research question 3 suggest that this relationship is not a reciprocal one. Team flow was found to not to predict CZPD over time. Discussed in Chapter II, flow is considered as a psychic compass that drives people to repeat the tasks or activities that lead them to experience flow. In other words, the nature of team flow has to do with an intrinsic motivation to the team task but not necessarily to any specific collaboration structure. Because CZPD represents a dynamic and adaptive peer-learning structure, it is understandable why the experience of team flow does not predict CZPD over time. This finding emphasises that the psychological environment of the peak performance experience of team flow, either in the form of synchronised or frictional, is task-focussed.

TFa explaines the relationhip between CZPD and TF. CZPD is a strucutual breeding groud for team effectiveness not solely for TF, but other propoties as well. TFa bridges and channel this effectinvess to the emergence of TF as one possible manifestation of team effectiveness. This is also illustrated by the reciprocal relationhip between CZPD and team efficacy. this finding supports and underscores the importance of establishing CZPD in project teams as a means to achieve a varitie of team effectiveness. Also confirming the theorisation of core TF as a form of intense optimal performance state that is rarely experienced and only emerge as a result of the its precursors, namely the balance between skill and challenge, goal clearity and immidate feedback, which are also considered by Quinn (2005) and Jackson (reach model) as the shallower form of flow. Also, that CZPD predicts CE confirms to this interpretation. CZPD promotes team effectiveness in all different forms.

8.1.4.1 Summary of the validation process of CZPD

The findings in relation to research questions 4 and 5 provide test-criterion evidence to the CZPD scale, demonstrating that CZPD predicts team efficacy and team flow through the mediating effect of team flow antecedents. As a new scale, before any credible and meaningful findings can be drawn from using it, initial validation evidence is needed to examine whether the proposed CZPD scale measures the construct theorised. Although it was not the main objective of this research, in order to test PBrTF model, this research has also accomplished an initial validation process of CZPD based on the recommend best practice discussed in Chapter III. A summary of this validation process is provided here.

To reiterate the core of the concept, as is discussed in Chapter II, this research conceptualises CZPD as a social breeding ground for the establishment of a peer-learning self-organising system. In other words, CZPD facilitates team development by encouraging peer learning and promoting efficient utilisation of internal resources in the team. Therefore, a team that is high on CZPD is capable of adapting itself effectively in response to the changes from external demand by balancing between redundancy and diversity in the team. Such an adaptive team is considered to function as the behavioural resources for team flow in the proposed PBrTF model, which hypothesised that CZPD predicts team flow and team efficacy. This definition has defined the nature of CZPD and its function as a behavioural resource for team efficacy and team flow in the PBrTF model. As CZPD is theoretically orientated towards the application to the organisational and applied settings, specifically, in project team contexts, starting from the literature review, this thesis has undertaken the validation process by following the best practice recommendations for scale construction in organisational research by Wright et al. (2017; See Chapter III for a brief discussion). Using the visual aid of a flowchart (Figure 8-1), the discussion now turns to account for this validation process of CZPD.

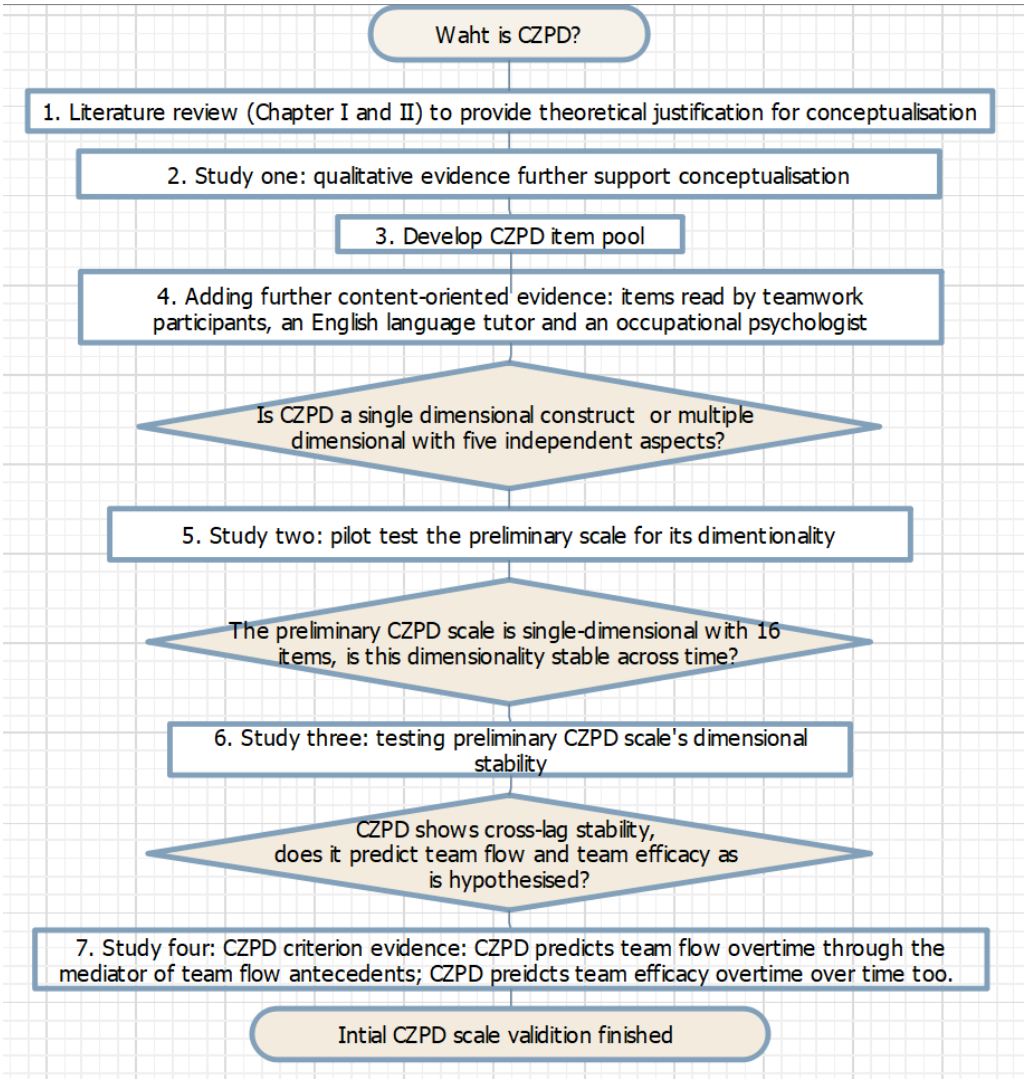


Figure 8- 1. CZPD scale development flowchart.

According to the American Educational Research Association (AERA), American Psychological Association (APA), and National Council on Measurement in Education (NCME; 2014), a validation process normally involves revisions in the test and/or the conceptual framework. Validation will also be applied to the revised test and interpretation of the test. Validity is a single concept with different types of evidence which indicates the extent to which the evidence gathered supports the proposed interpretation of the test scores. Generally, multiple sources of evidence are incumbent for adequate support for the interpretation proposed. However, this does not mean that all types of validity evidence are required in every setting (AERA, APA & NCME, 2014). For example, in this thesis, as CZPD was only theorised of its conceptual meaning and

predictive power, therefore, the initial validation process does not necessarily require convergent and divergent evidence, which indicates the relatedness of this test with tests of similar and opposite constructs. Therefore, this thesis has tested and provided the initial test content validity evidence, internal structure evidence, structural invariance evidence and test-criterion evidence of CZPD.

The validation process started with a question of "what is CZPD" as illustrated in Figure 8-1. Validity evidence derived from the analysis of the associations between the content of a test and the construct it intends to measure is considered as the test content validity evidence (AERA, APA & NCME, 2014). Test content often includes the themes, wording and or format of the items etc. The content domains of CZPD involves the classification of the themes, subthemes and types of items that were substantiated by the relevant description and propositions from the literature (see detailed discussion in Chapter II) and the findings from study 1 (Steps 1 and 2 in Figure 8-1). After the development of the 43-item pool, further support of the content validity was sought for the endorsement of the items from teamwork participants, an occupational psychologist and an English language educator (Steps 3 and 4 in Figure 8-1). The purpose of this process is to test the representativeness of the test items of the intended construct. As discussed in Chapter III, up to this stage, regarding the development and testing of CPZD, this thesis has conducted research considering the first two best practice recommendations by Wright, et al., (2017). The CZPD item pool developed after study 1 is grounded in a rich theoretical framework, which rationalised the five conditions of CZPD, namely idea interaction, decentralised control, diversity, redundancy and organised randomness, on the Team Compilation Theory (Kozlowski & Bell, 2013) and the Multilevel Theory (Kozlowski et al., 1996; Kozlowski et al., 1999; Kozlowski & Klein, 2000).(Vygotski, davis and Simmt) The findings from Study 1 further support the content domains and categories of CZPD, or the features of an effective self-organising system. Based on such a strong theoretical framework and the support of qualitative evidence, the researcher generated the 43 items comprising the total item pool. This approach was defined by Hinkin (1995) as "logical partitioning" which is deductive in nature as it is based on an a priori understanding of CZPD. In addition, to maintain the richness of the data, I have also employed an inductive

approach to allow new themes to emerge from the data. In the reflexivity section in Study 1, my experience of using such a hybrid approach was discussed. Although the original conceptualisation of CZPD assumed that the construct comprises five aspects, the empirical evidence from study 1 suggested that CZPD might be a unidimensional concept. As illustrated in Figure 8-1, the decision-making flowchart shows that this thesis has undertaken four steps to answer the question of "*what is CZPD*" and arrived at the new question of "what is the dimensionality of CZPD?".

To answer this question, Study 2 followed the best practice recommendation #3 (Wright et al., 2017), and conducted a pilot test of this preliminary scale with the 43 items. According to Slavec and Drnovsek (2012), a pilot study is very useful in improving the psychometric rigour of a new scale. To make the scale more generalisable to the general working population, Study 2 sampled working adults who, at the time of the survey, were involved in team projects or had been involved in team projects in the past year. Using Mokken Scale Analysis based on the Item Response Theory, the findings from Study 2 provided validity evidence for CZPD based on its internal structure. The internal structure of a test refers to the relationship between test items and test components. The extent to which this structure conforms to the proposed conceptual framework is referred to as the evidence based on the internal structure (AERA, APA & NCME, 2014). The evidence based on the internal structure of a test has an important influence on the interpretation of the test score. In the case of Study 2, the results suggest that CZPD has a unidimensional structure with 16 items, which tap into all five conditions for an effective self-organising system proposed by Davis and Simmt (2003), clustered to form a meaningful scale. The findings support the empirical evidence from Study 1, suggesting that CZPD emerges as the result of the interplay and coordination of its five conditions. In other words, CZPD can be seen as the emergence of a unit level "intelligence", which enables the team to best utilise its internal resources in accordance with the changing demand of the tasks. This interpretation concurs with the definition of complex systems discussed in Chapter I, which describes that complex systems emerge from the interaction of their agents and is capable of adapting and learning to respond to internal and external changes, or to say that they "*change their*

operation through operating" (Davis & Simmt, 2003). This interpretation describes CZPD as a unit-level emergent property which means that CZPD, similar to team flow and team efficacy and as described in the IMOI model, is a bottom-up effect which cannot be represented by the sum of the individual agents and therefore cannot be analysed by cutting them into parts. Based on the propositions of Kozlowski (2015), CZPD is thus seen as the most dynamic type of meso-level construct and is therefore operationalised by aggregating member's responses to represent a team level score in the subsequent analysis.

Up until this stage, this thesis has moved to the second decision point in the flowchart (Figure 8-1), where the information is needed to evaluate whether this unidimensionality of CZPD is stable across time. As the final study is a longitudinal design, cross-lagged dimensional invariance is an important psychometric property to examine before proceeding. Study 3 followed best practice recommendation #4 and # 5, tested the stability of CZPD's internal structure across time lag in a new sample. To ensure that most of the participants could take part both at the beginning and the end of their team project, study 3 used undergraduate and postgraduate student project teams considered to be closely representative of the research population. Although they are not strictly speaking from the work force, they are independent self-organising project teams assembled to finish assigned projects. Using a different and significantly larger sample, the results from study 3 further supported the conclusion of Study 2, demonstrating that CZPD is a unidimensional scale with satisfactory internal consistency level and that its internal structure is stable over time. In other words, evidence of a stable internal structure supports the interpretation of CZPD as a unitary construct characterised by the interaction of five aspects.

With the confidence of the stability of the internal structure of CZPD, study 4 follows Wright et al.'s, (2017) best practice recommendation #6, seeking CZPD's validity evidence based on its relationships to other variables. This type of evidence is needed when the proposition of the construct implies that the construct is related to other variables. Such type of evidence is gathered from the analyses of the relationships between the test score and other variables. The evidence based on relations to other variables is an important source of validity

information as it testifies the degree to which the proposed connection between the variables is consistent with the interpretation of the focal construct. Also, this type of evidence is needed to establish the nomological network of new constructs such as CZPD. The thesis hypothesised that CZPD serves as the behavioural resources of team flow within the PBrTF model, which specifies that CZPD would significantly predict team flow and team efficacy over time. The results supported the hypotheses, showing that CZPD predicts team flow over time via its influence on team flow antecedents and that CZPD predicts team efficacy over time as well. This evidence supports CZPD's function in the PBrTF model, suggesting that, high levels of CZPD predict high levels of team flow antecedents, which in turn, leads to a higher level of team flow. From a nomological network perspective, this evidence supports the conceptualisation that CZPD serves as a social breeding ground for indicators of team effectiveness, such as team flow and team efficacy.

Following the recommended best practice of scale development proposed by Wright et al., (2017) and the standards for psychological testing recommended by the American Educational Research Association, American Psychological Association, and National Council on Measurement in Education (2014), this research has developed and tested the CZPD scale in four studies on three sets of different samples. Integrating the validity evidence of CZPD based on the test content, internal structure and test-criterion relationships, this research has concluded initial CZPD scale validation and arrived at the endpoint of the flowchart of Figure 8-1.

The results to research question 2 and research question 4 also illustrate important features of the concept of team flow antecedents. As discussed in Chapter II and in Study 4, the team flow core experience was measured by adapting Bakker's (2008) WOLF scale. This scale only measures the three core aspects of a workplace flow experience, excluding the flow antecedents proposed in the nine-element model by ( ). Therefore, this research has adapted the first twelve items of the FFS (Tenenbaun et al., 1999; Quinn, 2005) questionnaire as a measure of team flow antecedents. Discussed in study 3 and in section 8.1.3, this research has provided internal structure and criterion-based validity evidence for the Team Flow Antecedents (TFa) scale. Specifically, the results have

demonstrated a very strong unidimensionality and cross-time dimensional stability of the TFa scale. In addition, the findings have demonstrated that as was predicted, the TFa scale predicts team flow over time. The above evidence has illustrated that team flow antecedents represent a more comprehensive view which includes not just the balance between skill and challenge, but also goal clarity and feedback clarity. This explains why contrary to findings in Salanova et al. (2014), in research question 2, it was found that team efficacy did not predict team flow antecedents. Salanova et al. (2014) used only the balance of skill and challenge as team flow antecedents, which are considered to be directly related to how confident team members are about their collective task-specific ability. In this research, however, team flow antecedents represent a broader evaluation. The combined effect of balance between skill and challenge, goal clarity and feedback clarity are therefore less closely related to team efficacy. Considering research question 4, the indirect relationship found between CZPD and team flow has also demonstrated the important role of team flow antecedents in bridging the effect of the CZPD and team flow. The findings from the four studies in this research have demonstrated that team flow is an intense but fragile and transient experience that, although signifying a collective peak performance experience, only elicits task-focused intrinsic motivation. It is not related to the improvement of the process of collaboration, or at least not the *frictional* form of team flow. Therefore, the team flow antecedents, (as a shallow form of flow) play an important role in translating the effect of CZPD, which is a form of effective team organisation, to team flow core, the deepest and most fragile form of flow experience.

Taken together, the results in study 4 partially support the proposed PBrTF model, demonstrating that team efficacy enhances the effectiveness of team organisation but it reduces the likelihood of team flow experience possibly due to a complacency effect. CZPD as an effective self-organising structure improves members' team efficacy and promotes the experience of team flow but only through the mediational effect of team flow antecedents. Team flow antecedents represent a more comprehensive construct that leads to the effect of CZPD on team flow. The concept of team flow, although signifying peak performance in the team, depletes team efficacy slightly probably due to the sense of frustration and struggle that the *frictional* form conveys. Also, because team

flow as a psychic compass only drives intrinsic motivation in project tasks, it does not help enhance a team's coordination process.

In summary, the above discussion has addressed the research objectives and the detailed research questions and hypotheses by reviewing and integrating the findings from the four studies in this thesis. However, there are several caveats that could potentially influence the interpretation of these findings. The next section focus on a discussion of the limitations of this research.

8.2 Limitations

The methodological design of this research was conducted with great care and effort to ensure that it could stand up to scrutiny, however, there are still several limitations need to be addressed. Firstly, as the PBrTF model was designed to target the project teams in the workplace, it is necessary to sample project teams from real world organisations. The data of this study were collected from two main sources: student project teams and working adults who have been involved in team projects. As is described in the methodology chapter, the team processes that the student project teams were subjected to were quite similar to that of the real-world business teams, which bolsters the reliability of study 1, 3 and 4. Despite this, student project teams cannot be completely representative of the workplace project teams. The differences mainly reside in the contextual variabilities in the workplace or the macro level. As discussed in Chapter I, team level phenomena can derive from lower level individual interactions, which is termed as a bottom-up effect. In addition, the functioning of teams is also influenced by top-down effects, which are imposed from the organisational or industry level. Such macro-level effects can be organisational culture or industry regulations, which exert a great influence on employee behaviours and perceptions. In this research, as the project teams are all sampled from the same university, no significant contextual differences were expected. Therefore, the methodological design and the research analysis have mainly focused on the bottom-up effects in student project teams. Also, although the participants of Study 2 were sampled from the working population, as the aim of Study 2 was to pilot test the CZPD scale, the analysis was conducted at an individual level and of participants that are not all from project

teams. The rationale for this decision was based on a practical consideration of time pressure and sample relevance to the research question. Study 2 is a pilot study, with a simple purpose of testing and selecting items from the initial item pool, reducing the length of the CZPD questionnaire. An item pool is created with the aim of generating a saturation of items to cover all aspects of the latent construct. Some items are generated purposefully to express the same meaning using different wordings. Therefore, there will be redundant items or items that might be more or less relevant to the targeted latent trait. Distributing all 46 items from the item pool together with the Team Flow, Team Efficacy scales is not practical because long questionnaire tired out participates quickly and reduces the validity of their answers. Therefore, the main aim is to select items that are the best representation of the latent variable of CZPD. At this stage, for a pilot study that only concerns the item relevance to teamwork, participants with teamwork experience are good enough. Also, the possible impact of this potential drawback has been examined rigorously in study 3, which tested the dimensionality and measurement invariance of the CZPD questionnaire using project team members. The finding in study 2 is replicated Study 3. Therefore, considering the practical time constraints, the sampling strategy of this research was justifiable as the characteristics of the participants and their teams suited the purposes of the studies.

Another limitation of the research design in this thesis is that, although study 4 employed a longitudinal design to draw causal inferences, a two-wave cross-panel model has limitations. As discussed in section 7.2.1.5, in a longitudinal design, to ensure the reliability of the results, a cross-lagged panel model normally has three underlying assumptions, stability, equilibrium and stationarity (Cole & Maxwell, 2003; Kenny, 1979; MacKinnon, 2008). Study 3 was devoted to testing the stability assumption, which was the cross-lag dimensional invariance of the measures. The results demonstrated that all measures have an acceptable level of stability in terms of inter-individual differences, intra-individual differences and intra-individual changes. In Study 4, the equilibrium assumption of the latent variable system was also tested and results demonstrated that the variance-covariance of the latent variable system was constant across the time-lag. Equilibrium in a dataset implies that the relationship between variables are stable and the causal inference drawn from the analysis is reliable. Although the research

was able to test and demonstrate that the assumptions of stability and equilibrium hold for the dataset, to examine the stationarity assumption, there is a need for at least three waves because stationarity describes a stable casual structure over time (Cole & Maxwell, 2003; Preacher, 2015). With fewer repeated measures, study 4 had to make the assumption of stationarity. However, the stability and equilibrium attributed in the dataset has provided substantial support for the validity and reliability of the interpretation and generalisability of the findings in study 4.

Social desirability is another frequently reported type of response bias which refers to people's tendency to respond to survey items in a socially favourable way (Edwards, 1953). This is one common source of bias that threatens the validity and reliability of the research results in social science. As the constructs investigated in this research, such as team efficacy, team flow are generally perceived as positive attributes, this questionnaire can be considered to be susceptible to social desirability. However, Crown & Marlowe (1964) suggests that social desirability is not necessarily a deliberate act of the respondent, but rather an unconscious tendency. Therefore, approaches designed to overcome social desirability ought to avoid falsely invalid responses. There are different approaches available to overcome some of the influence of social desirability. For example, Podsakoff, MacKenzie, Lee, and Podsakoff (2003) have recommended that in designing a questionnaire, items should be worded in a concise and unobvious manner. Also, it would help if the items are phrased as neutral as possible. When administering questionnaires to participants, Nederhof (1985) suggests that self-administration would help to reduce the influence of social cues and therefore, decrease the effect of social desirability. In this research, the researcher has tried to manage and minimise the influence of social desirability. As discussed in section 8.1.4, the CZPD scale items were reviewed by different people to ensure that the wording was as neutral and unobvious as possible. Although some of the CZPD items were longer than others, it is considered less of a problem because these items are descriptors of observable behaviours, which are neutral and do not express preferences. Also, the questionnaire was self-administered; the *Participant Information Sheet* and the *Content Forms*, provided participants with information about the procedures taken to ensure anonymity of responses. The participants for study 3 and 4 were asked to put in their date of

birth as a code to match their responses across time. Although this information would not make the participants' responses identifiable, the researcher assured participants of the confidentiality of their data. The raw data will be sent to achieve and destroyed in seven years after data analysis. Lessened the concern to be identified, the participants would be less likely to responded in a socially desirable way. Taken together, this research has tied to minimise the impact of social desirability from the design and the administration of the questionnaire.

In spite of the aforementioned limitations, the research has made important contributions to the research filed on team effectiveness both theoretically and practically. The discussed now turn to look at these contributions.

8.3 Theoretical contributions

This thesis has had several theoretical contributions to the research area of team effectiveness. Firstly, the significant relationships found between the behavioural, psychological and environmental components in the proposed PBrTF model demonstrated the value of combining the insights of the IMOI, SCT and the Broaden and Build theory to form a meta-theoretical framework in exploring the processes of team effectiveness. Although as is discussed in Chapter II, SCT had been used as the theoretical underpinnings for the discussion about team efficacy in other research, SCT had mainly been used in framing psychological processes on the individual level. Combining the IMOI heuristic of team effectiveness, this thesis used SCT to frame the team level phenomena of team efficacy, team flow, team flow antecedents and CZPD in a reciprocal and dynamic relationship. Specifically, based on the proposition of IMOI, team-level variables are thought to be dynamic and the outcome of one cycle of a team process that can be seen as the input or mediators for the next cycle. Moreover, IMOI also proposes that the emergent team level phenomena such as team efficacy, team flow and CZPD are most sensitive to this type of carry-over effect, therefore, making the team process dynamic and cyclical. Also, because of this dynamic nature and sensitivity to manipulation, emergent team level phenomena are considered as the most cost-effective variables for intervention programmes. Thus, building on the IMOI heuristic, this thesis used SCT to further refine the

team effectiveness model by identifying a reciprocal relationship between the psychological, behavioural and environmental components in the process of teamwork.

However, neither the IMOI nor the SCT has specified the nature of these dynamic and reciprocal relationships between the three main components. To this end, considering the positive, motivational, meaning-giving and enabling nature of the studied variables, this thesis used the lens of the Broaden and Build theory to propose the PBrTF model. Specifically, as proposed by the Broaden and Build theory, positive emotions generated by the experience of team flow broadens team members' awareness of their team resources, encourages them to explore each other's thoughts and skills, and as a consequence, build the team's unit-level ability. This development feeds and is fed by team efficacy in order to take up more challenges, and continuously upgrade team effectiveness as a result of the dynamic, reciprocal interaction between the psychological (team efficacy), behavioural (CZPD) and environmental (team flow) components in the PBrTF model. This thesis has thus contributed to the research on team effectiveness by developing and testing the PBrTF model based on the combined insights of three models - the IMOI, SCT and Broaden and Build theories of positive psychology.

Moreover, as is discussed in section 8.1.4, the four studies in this thesis also contribute to the development and testing of the concept of the collaborative zone of proximal development (CZPD). Based on the five conditions of self-organising systems proposed by David and Simmt (2003), this thesis saw an opportunity to further develop the construct of CZPD based on the propositions of the team compilation theory (Kozlowski et al., 1999) and the Multilevel Theory (Kozlowski et al., 1996; Kozlowski et al., 1999; Kozlowski & Klein, 2000). Prior to this thesis, the discussion of CZPD has primarily been based on the logic of the Zone of Proximal Development (ZPD). Although the literature acknowledges that CPZD is a collective form of ZPD that emphasises an equal-status interaction instead of an expert-novel exchange, because of the limitation in ZPD's explanatory power for a collective level construct, CZPD has not seen much development theoretically or operational wise. To remedy this, this thesis uses the insight of team compilation theory and the Multilevel Theory to explain and clarify

the emergence of CZPD an effective self-organising system. Moreover, in light of the empirical findings from study 1, 2 and 3, this thesis further advanced the original theorisation of Davis and Simmt (2003) by proposing that CZPD is a single dimensional construct, which emerges as the result of the interplay and coordination of the four aspects, idea interaction, decentralised control, diversity and redundancy. The fifth aspect of CZPD manifests as a unit-level capability, which balances diversity and redundancy in accordance with the task requirement. The study has thus developed and advanced the concept of CZPD.

In addition to CZDP, the findings from Study 4 contribute to the theorisation of the construct of team efficacy and team flow by questioning the nature and function of these two variables. The counter-intuitive results in Study 4 demonstrated that the supposedly positive constructs of team flow and team efficacy, in fact, share a mutually defeating relationship. In other words, contrary to expectation, more team flow experience results in a decline in team efficacy beliefs, and also, the more confident a team is about its task-related ability, the harder it is for the team to experience team flow. This finding question whether team flow and team efficacy always function as an enabling and energy-giving force or whether the positive nature of these two constructs actually work within a boundary condition. Tentative explanations have been provided in this thesis. Specifically, the findings from Study 1 suggested that team flow has two modes, one emerges in a cohesive environment and elicits an enjoyable experience. The other mode appears while a team is focused on diversity and innovation, as members work through disagreements and misunderstanding; the experience is more akin to frustration although the team is still focused and motivated. For team efficacy, the literature has suggested that it has a nonlinear relationship with performance and that high levels of efficacy can work to demotivate and disengage team members due to a sense of complacency.

In summary, theoretically, speaking, this thesis has contributed to the research area of team effectiveness by proposing and testing the PBrTF model by creatively combining insights from the IMOI, SCT and the Broaden and Build theory of positive psychology. Also, this thesis has developed and advanced the concept of CZPD by integrating the team compilation model, the Multilevel

Theory framework and the conditions for the emergence of effective self-organising systems. Finally, the findings of this thesis have put forward a question over the completeness of the theorisation of the concept of team flow and team effectiveness. Next, we turn to the implications of these contributions and how these inform future research.

8.4 Implications and suggestions for future research

8.4.1 Implications

This thesis offers several implications for future research and practical applications. The PBrTF model attempted to explain team effectiveness in terms of team flow by proposing a triadic relationship between teams' psychological, environmental and behavioural elements. Building on the combined insights of the SCT model, the IMOI framework and Broaden and Build theory, the PBrTF model offers a framework for future research on team effectiveness. The findings illustrated that team effectiveness as an emergent phenomenon is best cultivated by enabling a mutually reinforcing relationship between emergent team level affective perceptions, an optimal collaborative structure and interaction configuration, and emergent team level motivational states. Although the counterintuitive findings in Study 4 suggest that team efficacy and team flow might be mutually defeating, this does not disprove the effect of the triadic feedback loop between the psychological, behavioural and environmental elements in promoting team effectiveness. Therefore, future research of team effectiveness could use the implications of the PBrTF model as a guide for their research design, identify variables with similar functions, for example, replacing team effectiveness with another type of psychological resources to enhance the inclusiveness of the PBrTF model.

The PBrTF model could also have practical implications on team management practice, human resources systems, as well as organisational policies. The results from Study 4 indicate that CZPD directly predicts team efficacy, and also predicts team flow via the mediating effect of team flow antecedents. These results suggest that CZPD can be used to leverage intervention programmes that

promote team effectiveness in the form of team efficacy and team flow. Specifically, because CZPD has been operationalised using specific behavioural indicators such as idea interaction and decentralised control, team leaders could use the CZPD scale as a tool to monitor the patterns of team collaboration and help accelerate the process of team effectiveness by regulating team collaboration behaviours. For example, to resource equal status learning and development in a project team, a team manager could start by intentionally selecting members from diverse backgrounds. In order to enable mutual learning and benefit from this diversified knowledge reservoir during the teamwork process, the team leader could use the *idea interaction* items to monitor and regulate the communication structure and ratings on the items representing *diversity* aspect to evaluate the effect of idea exchange. Similarly, the *redundancy* items could inform the team leader the degree to which a common ground for collaboration has been formed. With the three aspects of CZPD in check, and the establishment of a collective level "intelligence", the items reflecting the *decentralised control* aspect of CZPD could, in turn, assist a team leader in ensuring that members have focussed their attention on the collective goal and not some other member. In other words, *decentralised control* makes sure that no one is dominating the team and intercepting the emergence of collective intelligence. Thus, as suggested by the Team Compilation Model, by using the CZPD scale, a team leader or team manager can monitor and accelerate the emergence of team intelligence, which could serve to activate the triadic feedback dynamic between the emotional, behavioural and environmental elements suggested by the PBrTF model of team effectiveness.

The research findings also caution practitioners that they need to be heedful when they observe that their project teams exhibit a high level of team efficacy. Contrary to expectation, the findings from Study 4 suggest that, as the magnitude of team efficacy level increases in a team, the members from the sampled teams find it harder to experience team flow. Similar results from Rapp et al., (2014) suggested that a high level of team efficacy creates a sense of complacency in a team which demotivates the members to invest efforts and encourages procrastination. When a high level of team efficacy disengages members from the task, the team finds it hard to experience team flow due to lack

of motivation and concentration. The team thus loses its momentum to maintain team effectiveness. Therefore, when team managers observe a high level of team efficacy, it is advised that they examine the team's affective and motivational environment using a team flow scale in order to avoid a damaging effect on performance in the long run. Team efficacy and team flow are identified as indicators of team effectiveness because as emergent properties at the team level, they are sensitive to internal and external changes. Therefore, in addition to being used in team effectiveness intervention programmes, they can also be used as team effectiveness "meters" which can give team managers a quick reading of each team's status and an opportunity to intervene before the problem affects performance.

Team managers are also advised to pay attention to team efficacy levels when their teams exhibit a high level of team flow. As the results from Study 4 indicate, a high level of team flow leads to a decrease in team efficacy. The discussion in Study 4 and section 8.1 suggests that as the key condition for flow is the perception of balance between skill and challenge, for a team to have a high magnitude of team flow, members are subjected to a demanding task that requires the team to put in full effort. Before the final outcome and feedback of their performance is given, members might experience a decrease in team efficacy because of a lack of mastery experience, which is one of the key sources of efficacy beliefs. Therefore, when a team manager observes an increase in team flow, it is possible that the team might experience a decrease in team efficacy. The team manager could then try to restore team efficacy levels by adjusting the collaboration structure in order to increase CZPD, which shares a mutually reinforcing relationship with team efficacy.

Overall, the findings of this study bridge the gap between team theories, the social cognitive theory, and Broaden and Build theory by proposing the PBrTF model. Integrating the insight from these three theoretical perspectives, the PBrTF model guides the design of future research on team effectiveness, demonstrating the potentials of applying the combined insight of the social cognitive theory and Broaden and Build theory to the explanation of team level phenomenon. The results from this research also inform practice, offering

observable indicators to assist team managers in monitoring and regulating team collaboration and promoting team effectiveness. The next section turns to look at the recommendation for future research and how to improve and develop on the current findings.

8.4.2 Future research

This research has developed and tested the PBrTF model, which is a tool to enhance team effectiveness built based on the SCT model, the IMOI framework and Broaden and Build theory. In section 8.3, the discussion of the theoretical contributions of this research highlighted that the PBrTF model has offered a framework to explore and develop a dynamic and positive process of team effectiveness between the emergent psychological, emotional and environmental properties on a meso-level. As such, there are several areas for the development of future research.

Firstly, based on the results from Study 4, contrary to what was expected, an increase in team efficacy was found to lead to a decrease in team flow and vice versa. In other words, instead of acting as the psychological resource for team flow, team efficacy actually impedes team flow and team flow depletes team efficacy. These findings suggest that team efficacy might not serve as a psychological resource for team flow. Therefore, based on the framework of PBrTF, future research could extend this and explore the relationship between a different unit-level construct and team flow with a view to identifying other variables that could promote the experience of team flow. Equally, considering that the PBrTF model is essentially a model of team effectiveness, future research could also expand and adapt this model by using a different criterion variable. Although team flow is defined as the experience of peak performance in a team (Sawyer, 2007), it is also found to be a fragile and elusive experience (Armstrong, 2008) that might not be readily applicable to units in organisations other than project teams. Therefore, future research could consider using other criterion variables of team effectiveness that offer greater generalisability in occupational settings.

Future research could also choose to replicate and further validate the findings from this research by using workers from various occupational groups. As discussed in section 8.2, one limitation of this research is that in Study 4, due to time constraints and access limitations, the researcher opted to sample student participants. Although the team formation processes of student project teams are similar to that of the project teams in occupational settings, because the targeted population of PBrTF is the workforce, it is recommended that future research replicate this study using project teams in the workplace to improve the generalisability of the results. Specifically, it is recommended that future research could replicate Study 1 to explore project team members' perceptions of the teamwork process and compare these with those of Study 1. One area of research interest would be to explore if workplace project teams are managed as self-organising peer learning systems, and if so, do the five aspects of CZPD play similar roles. Another area of interest to explore is whether project team members experience the dual forms of team flow as reported by the student team members. In Study 1, student participants described that the team flow experience manifested in two modes: the cohesive and the frictional. Contrary to the current literature, the participant only found the cohesive mode of flow enjoyable. The frictional mode of team flow elicited negative emotional reactions such as frustration. As these findings are new, evidence from the occupational setting is needed to corroborate the results.

In order to provide evidence to support the conceptualisation of CZPD, future research should seek to trace and monitor the dynamic process of the emergence of the study variables. Hypothesised as the behavioural resource of team flow, CZPD is deemed to play an important role in this reciprocal dynamic relationship. Based on the frameworks of Multilevel Theory (Kozlowski et al., 1996; Kozlowski et al., 1999; Kozlowski & Klein, 2000) and Team Compilation Theory (Kozlowski et al., 1999), this thesis has theoretically elaborated on the mechanism of the emergence process of CZPD. However, as the core aim of the proposed PBrTF lies in the reciprocal relationship between the focal research constructs, this research did not directly investigate this theorised mechanism of the emergence process of CZPD or any other research variables in this study. Information on the emergence process of team level properties illustrates the

fluctuation of the variables' dynamics and offers rich details of the observable behaviours. Such data not only serve as evidence to support the conceptualisation of the variable but also facilitate the design of interventions. Along the same lines, it would also be informative to trace and track the emergence process of team flow. As the result from study 1 suggests that team flow has a dual-mode nature, it is therefore suggested that using more advanced methodology, such as computational modelling (Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013), the method could simulate the emergence process and illustrate how experiencing different forms of team flow affects the types of emergence dynamics of team flow. For example, would a *frictional* form of team flow lead to divergent emergence and the *synchronised* mode lead to convergent emergence?

Apart from the emergence processes, there is also a need to expand the current analysis to multilevel design, exploring the PBrTF model by looking at how higher-level emergent phenomena affect the individual level cognitive processes. As the hypotheses of this thesis concern only the relationships between the meso-level variables, the research has, therefore, opted to aggregate the data to a team level and investigate the relationships only on the team level. However, as discussed in Chapter I and II, according to Multilevel Theory (Kozlowski et al., 1996; Kozlowski et al., 1999; Kozlowski & Klein, 2000), team-level variables emerge as a result of individual interaction. In other words, the team does not think or feel, the individuals do (Kozlowski, et al., 2013). Therefore, it is of theoretical and practical interest to explore how emergent phenomena form as a contextual variable to affect the relationships between the variables on the individual level.

There are many other directions that one could choose to pursue further. For example, using PBrTF as a framework, one way to expand and broaden the research is to explore whether other team-level variables could serve the function of psychological or behavioural resources of team flow. Alternatively, there are other promising indicators of team effectiveness that could serve as the environmental elements in this triadic model. Also, it is important to replicate the current research on a working population as the model is targeted at the occupational setting and new samples could also provide further validity evidence

for CZPD and the PBrTF model as a whole. Considering that the variables investigated in this study are all team level constructs, it would be beneficial to adopt new research methods such as computational simulation to trace and track the emergence dynamics of the constructs in order to facilitate better conceptualisation and intervention design. Finally, future research could also adopt a multilevel research design to investigate the influence of the bottom-up effect of the team level on the individual level relationships too.

8.5 Conclusion

Team effectiveness has been one of the dominating research topics in the field of social and organisational psychology in the past 60 years (Kozlowski, 2015). However, not all teams are effective or can remain effective at all times. With varying patterns of interactive structure, a team's dynamics can well range from conflict to cohesion at any given stage of team proceses and a team's effectiveness is therefore largely contingent on its dynamics and team processes (Kozlowski & Chao, 2012). Therefore, a practical question in is how to shape a team's interactive structure so it would promote the optimal forms of team dynamics that can be translated into team effectiveness. Team flow is one of the emergent states in team processes that has been recognised as a form of team effectiveness. As a collective state characterised with intense concentration, intrinsic motivation and work enjoyment, team flow is defined as the collective experience of optimal performance while team members are performing at the peak of their ability (Sawyer, 2007). With its many positive implications on performance, team affects and member well-being, it seems a promising route to investigate what contributes to the emergence of team flow.

To enhance team effectiveness, this thesis has developed and tested the Psychological and Behavioural model of Team Flow (PBrTF). Based on the combined heuristics of the Social Cognitive Theory (Bandura, 1977, 2006), the IMOI framework of team effectiveness (Mathiue et al., 2008) and the Broaden and Build theory of positive psychology (Fredrickson, 2004), this model suggests that team flow, team efficacy and the zone of proximal development (CZPD) share

a positive reciprocal relationship which becomes a positive force to enhance team effectiveness. Specifically, it was hypothesised that team efficacy and CZPD could serve as the psychological and behavioural resources that promote team flow and that these three variables would form a mutually reinforcing relationship and sustain a positive dynamics of team effectiveness. The overall purpose of this research was to develop and test the PBrTF model in the context of project teams.

CZPD has been identified as a key contributor, which directly promotes team efficacy and indirectly enhances team flow through the mediating effect of team flow antecedents. This finding in Study 4 suggested that CZPD served as a social breeding ground that nurture the dynamics of team effectiveness in terms of team flow and team efficacy. This pointed out how an optimal pattern of collaboration is the key for the emergence of team effectiveness. In addition to developing the conceptualisation and operationalisation of CZPD, the results of Study 1 also pointed out that team flow appeared to have two forms. One form is the synchronised team flow, which promotes team cohesion and elicits an enjoyable positive collective emotion as widely expected. Another form is the frictional team flow, which often happens when members are in disagreement with each other. Working through this stage of flow can have a temporary negative emotional response, which is a result of the sense of struggle. This result deepens the current understanding of team flow and identifies a new side to it that might facilitate the understanding of the fluctuation in the emergence mechanism of team flow throughout the team lifecycle. Contrary to the hypotheses, a counterintuitive finding in this research is that team efficacy and team flow were found to share a mutually defeating relationship. Although unexpected, this result can be explained by the *too-much-of-a-good-thing* effect observed in the organisational research. Iyengar and Lepper (2000), Jones and Williams (2000), Langfred (2004) and Pierce and Aguinis (2011) observed that some variables recognised as leading to desirable outcomes might produce negative consequences. In this research, it is possible that high-level efficacy breed a sense of complacency, which led to low team flow; and the frictional form of team flow, which left the team members in frustration and a sense of struggle, led to a decrease to team efficacy. Granted, this finding needs to be further validated in different samples. Nevertheless, this seemingly paradoxical finding serves as an admonition to team

effectiveness researchers and practitioner that the relationship between team flow and team efficacy seems to be more complicated than expected and that future research needs to explore more sophisticated ways to explain this relationship.

In summary, this research proposes a new framework of understanding and enhancing team effectiveness and highlights that the key to a healthy team dynamics is a healthy collaboration structure. Also, to promote the optimal team dynamics, the behavioural, psychological and environmental elements should all be carefully considered and examined. It is hoped that this research can assist the development of future research in the field of team effectiveness in occupational settings.

REFERENCES

Acock, A. C. (2013). *Discovering structural equation modeling using Stata: Revised edition*. Stata press.

Admiraal, W., Huizenga, J., Akkerman, S., & Ten Dam, G. (2011). The concept of flow in collaborative game-based learning. *Computers in Human Behavior*, *27*(3), 1185-1194.

American Educational Research Association, American Psychological Association, National Council on Measurement in Education, Joint Committee on Standards for Educational, & Psychological Testing (US). (2014). *Standards for educational and psychological testing*. Amer Educational Research Assn.

Andrich, D. (1978). Application of a psychometric rating model to ordered categories which are scored with successive integers. *Applied psychological measurement*, *2*(4), 581-594. https://doi.org/10.1177/014662167800200413

Arbucle, J. L. (2014). IBM® SPSS® Amos™ 23 user's guide. *Amos Development Corporation, IBM. Chicago, IL*.

Armstrong, A. C. (2005). *Group flow in small groups of middle school mathematics students* (Doctoral dissertation, University of British Columbia).Retrieved from https://open.library.ubc.ca/collections/ubctheses/831/items/1.0092452

Armstrong, A. C. (2008). The fragility of group flow: The experiences of two small groups in a middle school mathematics classroom. *The Journal of Mathematical Behavior*, *27*(2), 101-115.

Aronson, J. (1994). A pragmatic view of thematic analysis. The Qualitative Report, 2(1), 1–3.

Arthur Jr, W., Bell, S. T., & Edwards, B. D. (2007). A longitudinal examination of the comparative criterion-related validity of additive and referent-shift consensus operationalizations of team efficacy. *Organizational Research Methods*, *10*(1), 35-58.

Aubé, C., Brunelle, E., & Rousseau, V. (2014). Flow experience and team performance: The role of team goal commitment and information exchange. *Motivation and Emotion*, *38*(1), 120-130.

Baer, M., Leenders, R. T. A., Oldham, G. R., & Vadera, A. K. (2010). Win or

lose the battle for creativity: The power and perils of intergroup competition. Academy of Management Journal, 53(4), 827-845.

Bakker, A. B. (2005). Flow among music teachers and their students: The crossover of peak experiences. *Journal of vocational behavior*, *66*(1), 26-44.

Bakker, A. B. (2008). The work-related flow inventory: Construction and initial validation of the WOLF. Journal of vocational behavior, 72(3), 400-414.

Bakker, A. B., Oerlemans, W., Demerouti, E., Slot, B. B., & Ali, D. K. (2011). Flow and performance: A study among talented Dutch soccer players. *Psychology of Sport and Exercise*, *12*(4), 442-450.

Bakker, A. B., & van Woerkom, M. (2017). Flow at work: A self-determination perspective. Occupational Health Science, 1(1-2), 47-65.

Bandura, A (1977). "Self-efficacy: Toward a Unifying Theory of Behavioral Change" (PDF). Psychological Review. 84 (2): 191–215. doi:10.1037/0033-295x.84.2.191. PMID 847061.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American psychologist*, *37*(2), 122-147.

Bandura, A. (1986a). Social foundations of thought and action (pp. 5-107). Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1986b). The explanatory and predictive scope of self-efficacy theory. *Journal of social and clinical psychology*, *4*(3), 359-373.

Bandura, A. (2000) Exercise of human agency through collective efficacy, Current Directions of Psychological Science, 9, 75–78

Bandura, A. (2006) Toward a psychology of human agency, Perspectives on Psychological Science 1(2): 164-180.

Bandura, A. Barbaranelli, C. Caprara, G. V. & Pastorelli, C. (1996). "Multifaceted Impact of Self-Efficacy Beliefs on Academic Functioning". *Child Development*. 67 (3): 1206–1222. doi:10.1111/j.1467-8624.1996.tb01791.x.

Bandura, A., Blanchard, E. B., & Ritter, B. (1969). Relative efficacy of desensitization and modeling approaches for inducing behavioral, affective, and attitudinal changes. *Journal of Personality and social Psychology*, *13*(3), 173.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and

statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Bassi, M., & Delle Fave, A. (2004). Adolescence and the changing context of optimal experience in time: Italy 1986–2000. Journal of happiness studies, *5*(2), 155-179.

Bassi, G. L., Zanella, A., Cressoni, M., Stylianou, M., & Kolobow, T. (2008). Following tracheal intubation, mucus flow is reversed in the semirecumbent position: Possible role in the pathogenesis of ventilator–associated pneumonia. *Critical care medicine*, *36*(2), 518-525.

Baumgartner, J. (2015). The influence of flow on standard and adaptive performance in teams. (Master's Thesis) Retrieved from https://etd.ohiolink.edu/

Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective leadership. Group and Organization Management, 27, 14-49.

Bentler, P. M. (2006). EQS 6 structural equations program manual. Encino, CA: Multivariate Software, Inc.

Biemann, T., Cole, M. S., & Voelpel, S. (2012). Within-group agreement: On the use (and misuse) of rWG and rWG (J) in leadership research and some best practice guidelines. *The Leadership Quarterly*, *23*(1), 66-80. https://doi.org/10.1016/j.leaqua.2011.11.006

Bliese, P. D. (1998). Group size, ICC values, and group-level correlations: A simulation. *Organizational research methods*, *1*(4), 355-373. https://doi.org/10.1177%2F109442819814001

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis. In K. J. Klein, & S. W. J. Kozlowski (Eds.), Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions (pp. 349–381). San Francisco: Jossey-Bass

Bliese, P. D., Chan, D., & Ployhart, R. E. (2007). Multilevel methods: Future directions in measurement, longitudinal analyses, and nonnormal outcomes. *Organizational Research Methods*, *10*(4), 551-563.

Bloom, H. (2000). Global brain: the evolution of mass mind from the Big Bang to the 21st century. New York: John Wiley & Sons.

Bommer, W. H., Johnson, J. L., Rich, G. A., Podsakoff, P. M., & MacKenzie, S.

B. (1995). On the interchangeability of objective and subjective measures of employee performance: A meta-analysis. Personnel Psychology, 48, 587-605.

Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. SAGE.

BPS. (2009). Code of ethics and conduct. Leicester: Ethics Committee of the British 225

BPS. (2010). Code of human research ethics. Leicester: The British Psychological Society.

BPS. (2013). Ethics guidelines for internet-mediated research. Leicester: The British Psychological Society.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brauner, P., Leonhardt, T., Ziefle, M., & Schroeder, U. (2010): The effect of tangible artifacts, gender and subjective technical competence on teaching programming to seventh graders. Proceedings of the 4th International Conference on Informatics in Secondary Schools (ISSEP 2010), LNCS 5941. pp. 61–71. https://doi.org/10.1007/978-3-642-11376-5_7

Bredin, K., & Söderlund, J. (2011). The HR quadriad: a framework for the analysis of HRM in project-based organizations. *The International Journal of Human Resource Management*, *22*(10), 2202-2221. https://doi.org/10.1080/09585192.2011.580189

Brown, T. A. (2015). Confirmatory factor analysis for applied research (2nd ed.). New York, NY; London: The Guilford Press.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological methods & research*, *21*(2), 230-258. https://doi.org/10.1177%2F0049124192021002005

Brown, R. D., & Hauenstein, N. M. (2005). Interrater agreement reconsidered: An alternative to the rwg indices. *Organizational research methods*, *8*(2), 165-184. https://doi.org/10.1177%2F1094428105275376

Brown, K. G., & Kozlowski, S. W. J. (1999, April). Toward an expanded conceptualization of emergent organizational phenomena: Dispersion theory. In F. P. Morgeson & D. A. Hofmann, (Chairs), New perspectives on higher-level phenomena in industrial/organizational psychology. Symposium

presented at the 14th Annual Conference of the Society for Industrial and Organizational Psychology, Atlanta, GA.

Bryman, A., Becker, S., & Sempik, J. (2008). Quality criteria for quantitative, qualitative and mixed methods research: A view from social policy. International Journal of Social Research Methodology, 11(4), 261–276. https://doi.org/10.1080/13645570701401644

Buss, A. R. (1974). A general developmental model for interindividual differences, intraindividual differences, and intraindividual changes. *Developmental Psychology, 10*(1), 70–78. https://doi.org/10.1037/h0035540

Byrne, B. M. (2013). Structural equation modeling with AMOS: Basic concepts, applications, and programming. New York, NY: Routledge

Caracelli, V. J., & Greene, J. C. (1993). Data analysis strategies for mixed-method evaluation designs. *Educational evaluation and policy analysis*, *15*(2), 195-207.

Carli, M., Fave, A. D., & Massimini, F. (1988). The quality of experience in the flow channels: Comparison of Italian and US students.

Castells, M., Fernandez-Ardevol, M., Qiu, J. L., & Sey, A. (2009). *Mobile communication and society: A global perspective*. Mit Press.

Casti, J. L. (1994). Complexification: Explaining a paradoxical world through the science ofsurprise. New York: HarperCollins.

Ceja, L., & Navarro, J. (2009). Dynamics of flow: A nonlinear perspective. Journal of Happiness Studies, 10(6), 665.

Chan, D. (1998). Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of applied psychology*, *83*(2), 234.

Chang, A., Bordia, P., & Duck, J. (2003). Punctuated equilibrium and linear progression: Toward a new understanding of group development. Academy of Management Journal, 46, 106-117.

Chen, G., Mathieu, J. E., & Bliese, P. D. (2005). A framework for conducting multi-level construct validation. In *Multi-level issues in organizational behavior and processes* (pp. 273-303). Emerald Group Publishing Limited.

Chiocchio, F., & Essiembre, H. (2009). Cohesion and performance: A meta-analytic review of disparities between project teams, production teams, and service teams. *Small group research*, *40*(4), 382-420.

https://doi.org/10.1177%2F1046496409335103

Chiocchio, F., Kelloway, E. K., & Hobbs, B. (Eds.). (2015). The psychology and management of project teams. Oxford University Press.

Clarke, S. G., & Haworth, J. T. (1994). 'Flow'experience in the daily lives of sixth-form college students. British Journal of Psychology, 85(4), 511-523.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1), 155-159.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. Journal of Management, 23, 239-290

Cole, M. S., Bedeian, A. G., Hirschfeld, R. R., & Vogel, B. (2011). Dispersion-composition models in multilevel research: A data-analytic framework. *Organizational Research Methods*, *14*(4), 718-734. https://doi.org/10.1177%2F1094428110389078

Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. Journal of abnormal psychology, 112(4), 558.

Collins, C. G., & Parker, S. K. (2010). Team capability beliefs over time: Distinguishing between team potency, team outcome efficacy, and team process efficacy. *Journal of Occupational and Organizational Psychology*, *83*(4), 1003-1023.

Condon,W. (1986). Communication: Rhythm and structure. In J. Evans &M. Clyne (Eds.), Rhythm in psychological, linguistic and musical processes (pp. 55–78). Springfield, IL: Charles C. Thomas

Coombs, C. H. (1964). A theory of data. Wiley.

Coultas, C. W., Driskell, T., Burke, C. S., & Salas, E. (2014). A conceptual review of emergent state measurement: Current problems, future solutions. Small Group Research, 45(6), 671-703.

Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks (CA); London; New Delhi: SAGE Publications.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of mixed methods in social and behavioral research*, *209*, 240.

Cronin, M. A. (2015). Advancing the science of dynamics in groups and teams.

Organisational Psychology Review, 5(4), 267-267. https://doi.org/10.1177%2F2041386615606826

Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? In J. P. Walsh & A. P. Brief (Eds.), The Academy of Management annals (Vol. 5, pp. 571–612). Philadelphia, PA: Taylor & Francis.

Crowne, D. P., & Marlowe, D. (1964). The Approval Motive. New York: Wiley.

Csikszentmihalyi, M. (1975). Beyond boredom and anxiety. San Francisco, CA: Jossey-Bass Publishers.

Csikszentmihalyi, M. (1990). Flow: The psychology of optimal experience. New York: Harper and Row.

Csikszentmihalyi, M. (1993). The evolving self: A psychology for the third millennium. New York: HarperCollins.

Csikszentmihalyi, M. (1997). Finding flow: The psychology of engagement with everyday life. New York: Basic Books.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (Eds.). (1992). Optimal experience: Psychological studies of flow in consciousness. Cambridge university press.

Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. Journal of Personality and Social Psychology, 56(5), 815–822.

Csikszentmihalyi, M., Rathunde, K. R., & Whalen, S. (1993). *Talented teenagers: A longitudinal study of their development.* Cambridge University Press.

Davis, O.C. (2018). Finding Flow and Microflow in Daily Life. *More Flow, More Well-being: Studies on How to Increase Flow in Daily Life and Reap the Benefits.* The 9th European Conference on Positive Psychology. Budapest, Hungary.

Davis, B., & Simmt, E. (2003). Understanding Learning Systems: Mathematics Education and Complexity Science. *Journal for Research in Mathematics Education, 34*(2), 137-167. doi:10.2307/30034903

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum Press.

Delle Fave, A., & Massimini, F. (2005). The investigation of optimal experience and apathy: Developmental and psychosocial implications. *European Psychologist, 10*(4), 264-274.

Delle Fave, A., Massimini, F., & Bassi, M. (2011). Psychological selection and

optimal experience across cultures: Social empowerment through personal growth (Vol. 2). Springer Science & Business Media.

Demerouti, E. (2006). Job characteristics, flow, and performance: The moderating role of conscientiousness. *Journal of occupational health psychology*, *11*(3), 266.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied psychology*, *86*(3), 499.

DeRue, D. S., Hollenbeck, J., Ilgen, D., & Feltz, D. (2010). Efficacy dispersion in teams: Moving beyond agreement and aggregation. *Personnel Psychology*, *63*(1), 1-40.

Dichter, M. N., Dortmann, O., Halek, M., Meyer, G., Holle, D., Nordheim, J., & Bartholomeyczik, S. (2013). Scalability and internal consistency of the German version of the dementia-specific quality of life instrument QUALIDEM in nursing homes–a secondary data analysis. Health and quality of life outcomes, 11(1), 91.

Diener, E. (2000). Subjective well-being, the science of happiness and a proposal for a national index. American Psychologist, 55, 34–43.

Dormann, C. F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., ... & Münkemüller, T. (2013). Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, *36*(1), 27-46. https://doi.org/10.1111/j.1600-0587.2012.07348.x

Doyle, L., Brady, A. M., & Byrne, G. (2009). An overview of mixed methods research. *Journal of research in nursing*, *14*(2), 175-185.

Driskell, J. E., Salas, E., & Driskell, T. (2018). Foundations of teamwork and collaboration. American Psychologist, 73(4), 334–348. https://doi.org/10.1037/amp0000241

Earley, P. C. (1999). Playing follow the leader: Status-determining traits in relation to collective efficacy across cultures. *Organizational behavior and human decision processes*, *80*(3), 192-212.

Edwards, Allen (1953). "The relationship between the judged desirability of a trait and the probability that the trait will be endorsed". *Journal of Applied Psychology*. 37 (2): 90–93. doi:10.1037/h0058073.

Eisenberger, R., Jones, J. R., Stinglhamber, F., Shanock, L., & Randall, A. T.

(2005). Flow experiences at work: For high need achievers alone?. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *26*(7), 755-775.

Elfenbein, H. A. (2014). The many faces of emotional contagion: An affective process theory of affective linkage. *Organizational Psychology Review*, *4*(4), 326-362.

Embretson, S. E., & Reise, S. P. (2000). Multivariate Applications Books Series. *Item response theory for psychologists. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers*.

Emons, W. H. M., Sijtsma, K., & Meijer, R. R. (2007). On the consistency of individual classification using short scales. *Psychological Methods, 12*(1), 105–120. https://doi.org/10.1037/1082-989X.12.1.105

Emons, W. H., Sijtsma, K., & Pedersen, S. S. (2012). Dimensionality of the Hospital Anxiety and Depression Scale (HADS) in cardiac patients: comparison of Mokken scale analysis and factor analysis. Assessment, 19(3), 337-353.

Engeser, S., & Schiepe-Tiska, A. (2012). Historical lines and an overview of current research on flow. In *Advances in flow research* (pp. 1-22). Springer, New York, NY.

Erikson, E. H. (1994). Identity and the life cycle. WW Norton & Company.

Feltz, D. L., & Lirgg, C. D. (1998). Perceived team and player efficacy in hockey. *Journal of applied psychology*, *83*(4), 557.

Fereday, J. & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. International Journal of Qualitative Methods, *5*(1), 80–92. https://doi.org/10.1177/160940690600500107

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. sage.

Fredrickson, B. L. (1998). What good are positive emotions? Review of General Psychology, 2(3), 300-319.

Fredrickson, B. L. (2003). The value of positive emotions: The emerging science of positive psychology is coming to understand why it's good to feel good. American Scientist, 91(4), 330-335.

Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. Philosophical Transactions-Royal Society of London Series B Biological

Sciences, 1367-1378.

Fredrickson, B. L., & Kurtz, L. E. (2011). Cultivating positive emotions to enhance human flourishing. In S. I. Donaldson, M. Csikszentmihalyi, & J. Nakamura (Eds.), Applied positive psychology: Improving everyday life, health, schools, work, and society (pp. 35–48). New York, NY: Routledge.

Fullagar, C. J., & Kelloway, E. K. (2009). Flow at work: An experience sampling approach. *Journal of occupational and organizational psychology*, *82*(3), 595-615.

Fusaroli, R., & Tylén, K. (2016). Investigating conversational dynamics: Interactive alignment, Interpersonal synergy, and collective task performance. *Cognitive science*, *40*(1), 145-171.

Gaggioli, A., Riva, G., Milani, L., & Mazzoni, E. (2012). *Networked flow: Towards an understanding of creative networks*. Springer Science & Business Media.

Gaggioli, A., Mazzoni, E., Milani, L., & Riva, G. (2015). The creative link: Investigating the relationship between social network indices, creative performance and flow in blended teams. *Computers in Human Behavior*, *42*, 157-166.

Geirland, J. (1996). "Go With The Flow". Wired magazine, September, Issue 4.09.

Gersick, C. J. G. (1988). Time and transition in work teams: Toward a new model of group development. Academy of Management Journal, 31, 9-41.

Gersick, C. J. (1989). Marking time: Predictable transitions in task groups. Academy of Management Journal, 32, 274-309.

Gibson CB. (1999). Do they do what they believe they can? Group efficacy and group effectiveness across tasks and cultures. Academy of Management Journal, 42, 138– 152. https://doi.org/10.5465/257089

Gibson, C. B., Randel, A. E., & Earley, P. C. (2000). Understanding group efficacy: An empirical test of multiple assessment methods. *Group & organization management*, *25*(1), 67-97.

Gilgun, J. F. (2005). "Grab" and good science: Writing up the results of qualitative research. *Qualitative health research*, *15*(2), 256-262.

Gilgun, J. F. (2008). Lived experience, reflexivity, and research on perpetrators of interpersonal violence. *Qualitative Social Work*, *7*(2), 181-197.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research.

The Qualitative Report, 8(4), 597–607.

Gollob, H. F., & Reichardt, C. S. (1991). Interpreting and estimating indirect effects assuming time lags really matter. In L. M. Collins & J. L. Horn (Eds.), *Best methods for the analysis of change: Recent advances, unanswered questions, future directions* (p. 243–259). American Psychological Association. https://doi.org/10.1037/10099-015

Goodman, P. S., Ravlin, E., & Schminke, M. (1987). Understanding groups in organizations. In L. L. Cummings & B. M. Staw (Eds.), Research in organizational behavior (vol. 9, pp. 121-173). Greenwich, CT: JAI Press.

Goos, M., Galbraith, P., & Renshaw, P. (2002). Socially mediated metacognition: Creating collaborative zones of proximal development in small group problem solving. *Educational studies in Mathematics*, *49*(2), 193-223.

Gordon-Calvert, L. M. (2001). Mathematical conversations within the practice ofmathematics. New York: Peter Lang.

Graef, R. (1975). Flow patterns in everyday life. In M. Csikszentmihalyi (Ed.), Beyond boredom and anxiety: The experience of play in work and games. (pp. 140-160). San Francisco, CA: Jossey-Bass.

Greene, J. C. (2008). Is mixed methods social inquiry a distinctive methodology?. *Journal of mixed methods research*, *2*(1), 7-22.

Greene, J. C., Benjamin, L., & Goodyear, L. (2001). The merits of mixing methods in evaluation. Evaluation, 7(1), 25–44.

Guastello, S. J., Johnson, E. A., & Rieke, M. L. (1999). Nonlinear dynamics of motivational flow. Nonlinear dynamics, psychology, and life sciences, 3(3), 259-273.

Guest, G., MacQueen, K. M., & Namey, E. E. (2011). *Applied thematic analysis*. Sage Publications.

Gully SM, Incalcaterra KA, Joshi A, Beaubien JM. (2002). A meta-analysis of team- efficacy, potency, and performance: Interdependence and level of analysis as moderators of observed relationships. Journal of Applied Psychology, 87, 819–832. http://dx.doi.org/10.1037/0021-9010.87.5.819

Guzzo, R. A., Yost, P. R., Campbell, R. J., & Shea, G. P. (1993). Potency in groups: Articulating a construct. *British journal of social psychology*, *32*(1), 87-106.

Hackman, J. R. (1987). The design of work teams. In J. Lorsch (Ed.), Handbook of organizational behavior (pp. 315-342). New York: Prentice Hall.

Hackman, J. R. (1992). Group influences on individuals in organizations. In M. D. Dunnette & L. M. Hough (Eds.), Handbook of industrial and organizational psychology (Vol. 3, pp. 199-267).

Hackman, J. R., & Morris, C. G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In Advances in experimental social psychology (Vol. 8, pp. 45-99). Academic Press.

Hackman, J. R., & Oldham, G. R. (1975). Development of the job diagnostic survey. *Journal of Applied psychology*, *60*(2), 159.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis: A global perspective (7th ed.). Upper Saddle River, N.J.; London: Pearson Education.

Hamilton, E., & Hurford, A. (2007, October). Combining collaborative workspaces with tablet computing: Research in learner engagement and conditions of flow. In 2007 37th Annual Frontiers In Education Conference-Global Engineering: Knowledge Without Borders, Opportunities Without Passports (pp. T3C-3). IEEE.

Hansen, T., L. Dirckinck-Holmfeld, R. Lewis, & J. Rugelj. (1999). Using telematics for collaborative knowledge construction. In Collaborative Learning: Cognitive and Computational Approaches, edited by P. Dillenbourg, 169ñ196. Amsterdam, The Netherlands: Pergamon.

Harris, K. J., & Kacmar, K. M. (2006). Too much of a good thing: The curvilinear effect of leader-member exchange on stress. *The Journal of social psychology*, *146*(1), 65-84. https://doi.org/10.3200/SOCP.146.1.65-84

Hart, E., & Di Blasi, Z. (2015). Combined flow in musical jam sessions: A pilot qualitative study. *Psychology of Music*, *43*(2), 275-290.

Hatch, M. J. (1999). Exploring the empty spaces of organizing: How improvisational jazz helps redescribe organizational structure. *Organization studies*, *20*(1), 75-100.

Hatfield, E., Bensman, L., Thornton, P. D., & Rapson, R. L. (2014). New perspectives on emotional contagion: A review of classic and recent research on facial mimicry and contagion.

Hattie, J. (1985). Methodology review: assessing unidimensionality of tests and ltenls. *Applied psychological measurement*, *9*(2), 139-164.

Hayes, A. F. (2017). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Publications.

Hayes, A. F. (2018). Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. *Communication Monographs*, *85*(1), 4-40. https://doi.org/10.1080/03637751.2017.1352100

Hemker, B. T., Sijtsma, K., & Molenaar, I. W. (1995). Selection of unidimensional scales from a multidimensional item bank in the polytomous Mokken I RT model. *Applied Psychological Measurement*, *19*(4), 337-352. https://doi.org/10.1177/014662169501900404

Hemker, B. T., Sijtsma, K., Molenaar, I. W., & Junker, B. W. (1997). Stochastic ordering using the latent trait and the sum score in polytomous IRT models. *Psychometrika*, *62*(3), 331-347. https://doi.org/10.1007/BF02294555

Heyne, K., Pavlas, D., & Salas, E. (2011, September). An investigation on the effects of flow state on team process and outcomes. In *Proceedings of the human factors and ergonomics society annual meeting* (Vol. 55, No. 1, pp. 475-479). Sage CA: Los Angeles, CA: SAGE Publications.

Hinkin, T. R. (1995). A review of scale development practices in the study of organizations. Journal of Management, 21, 967–988.

Hoelter, J. W. (1983). The analysis of covariance structures: Goodness-of-fit indices. *Sociological Methods & Research*, *11*(3), 325-344. https://doi.org/10.1177%2F0049124183011003003

Holland, R. (1999). Reflexivity. *Human Relations, 52*, 463-483.

Hollenbeck, J. R., Beersma, B., & Schouten, M. E. (2012). Beyond team types and taxonomies: A dimensional scaling conceptualization for team description. *Academy of Management Review*, *37*(1), 82-106. https://doi.org/10.5465/amr.2010.0181

Hollenbeck, J. R., Ilgen, D. R., Sego, D. J., Hedlund, J., Major, D. A., & Phillips, J. (1995). Multilevel theory of team decision making: Decision performance in teams incorporating distributed expertise. Journal of Applied Psychology, 80, 292-316.

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 1–55.

https://doi.org/10.1080/10705519909540118

Hunt, S. D. (1991). Modern marketing theory. Cincinnati: South-Western Publishing.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From i-p-o models to imoi models. *Annual Review of Psychology*.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology*, 79: 995-1006. https://doi.org/10.3200/SOCP.146.1.65-84

Jackson, S. A. (1995). Factors influencing the occurrence of flow state in elite athletes. Journal of Applied Sport Psychology, 7(2), 138–166.

Jackson, S., Kimiecik, S.K. Ford, H.W. Marsh Psychological correlates of flow in sport Journal of Sport & Exercise Psychology, 20 (1998), pp. 358-378

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. Journal of sport and exercise psychology, 18(1), 17-35.

Jackson, S. A., & Roberts, G. C. (1992). Positive performance states of athletes: Toward a conceptual understanding of peak performance. The Sport Psychologist, 6, 156–171.

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology, 69*(1), 85–98. https://doi.org/10.1037/0021-9010.69.1.85

Jones, C. I., & Williams, J. C. 2000. Too much of a good thing? The economics of investment in R&D. *Journal of Economic Growth, 5*, 65-85. https://doi.org/10.1023/A:1009826304308

Johnson, S. (2001) Emergence: The connected lives of ants, brains, cities, and software. New York: Scribner.

Johnson, P. and Duberley, J. (2003). Reflexivity in management research. Journal of Management Studies, 40, 1279-1303.

Johnson, R. B. Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. Journal of Mixed Methods Research, 1(2), 112–133. https://doi.org/10.1177/1558689806298224

Jones, T. L., & Prinz, R. J. (2005). Potential roles of parental self-efficacy in parent and child adjustment: A review. Clinical psychology review, 25(3), 341-363.

Jung, D. I., & Sosik, J. J. (2003). Group potency and collective efficacy: Examining their predictive validity, level of analysis, and effects of performance feedback on future group performance. *Group & Organization Management*, *28*(3), 366-391.

Kanfer, R., & Heggestad, E. D. (1997). Motivational traits and skills: A person-centered approach to work motivation. *Research in Organizational Behavior, vol 19, 1997*, *19*, 1-56.

Kawabata, M., Mallett, C. J., & Jackson, S. A. (2008). The flow state scale-2 and dispositional flow scale-2: Examination of factorial validity and reliability for Japanese adults. Psychology of sport and exercise, 9(4), 465-485.

Keeler, J. R., Roth, E. A., Neuser, B. L., Spitsbergen, J. M., Waters, D. J. M., & Vianney, J. M. (2015). The neurochemistry and social flow of singing: bonding and oxytocin. *Frontiers in human neuroscience*, *9*, 518.

Kelly, K. (1995). Out of control: The new biology of machines New York: Perseus.

Kelly, J. R., Futoran, G. C., & McGrath, J. E. (1990). Capacity and capability: Seven studies of entrainment of task performance rates. Small Group Research, 21, 283-314.

Kenny, D. A. (1979). Correlation and causality. *New York: Wiley*.

King, N. (2004). Using interviews in qualitative research. In C. Cassell & G. Symon (Eds.), Essential guide to qualitative methods in organizational research (pp. 11–22). London; Thousand Oaks CA; New Delhi: SAGE Publications.

Kline, R. B. (2012). Assumptions in structural equation modeling. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (p. 111–125). The Guilford Press

Klein, K. J., Conn, A. B., Smith, D. B., & Sorra, J. S. (2001). Is everyone in agreement? An exploration of within-group agreement in employee perceptions of the work environment. *Journal of Applied Psychology, 86*(1), 3–16. https://doi.org/10.1037/0021-9010.86.1.3

Klein, K. J., & Kozlowski, S. W. (2000). *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions*. Jossey-Bass.

Kozlowski, S. W. (2015). Advancing research on team process dynamics: Theoretical, methodological, and measurement considerations. Organizational Psychology Review, *5*(4), 270-299.

Kozlowski, S. W. (2018). Enhancing the effectiveness of work groups and teams:

a reflection. Perspectives on Psychological Science, 13(2), 205-212.

Kozlowski, S. W. J., & Bell, B. S. (2013).Work groups and teams in organizations: Review update [Electronic version]. Retrieved 24 November 2018, from Cornell University, School of Industrial and Labor Relations site: http://digitalcommons.ilr.cornell.edu/articles/927

Kozlowski, S. W. J., Brown, K. G., Weissbein, D. A., Cannon-Bowers, J., & Salas, E. (2000). A multi- level perspective on training effectiveness: Enhancing horizontal and vertical transfer. In K. J. Klein & S. W. J. Kozlowski (Eds.), Multilevel theory, research, and methods in organizations (pp. 157- 210). San Francisco, CA: Jossey-Bass.

Kozlowski, S. W. J., & Chao, G. T. (2012). The dynamics of emergence: Cognition and cohesion in work teams. Managerial and Decision Economics, 33, 335–354. doi:10.1002/mde.2552

Kozlowski, S. W., Chao, G. T., Grand, J. A., Braun, M. T., & Kuljanin, G. (2013). Advancing multilevel research design: Capturing the dynamics of emergence. *Organizational Research Methods*, *16*(4), 581-615. https://doi.org/10.1177%2F1094428113493119

Kozlowski, S. W. J., Gully, S. M., McHugh, P. P., Salas, E., & Cannon-Bowers, J. A. (1996a). A dynamic theory of leadership and team effectiveness: Developmental and task contingent leader roles. In G. R. Ferris (Ed.), Research in personnel and human resource management (Vol. 14, pp. 253-305). Greenwich, CT: JAI Press.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams (Monograph). Psychological Science in the Public Interest, 7, 77-124.

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions (pp. 3- 90). San Francisco, CA: Jossey-Bass.

Kozlowski, S. W. J., Gully, S. M., Nason, E. R., & Smith, E. M. (1999). Developing adaptive teams: A theory of compilation and performance across levels and time. In D. R. Ilgen & E. D. Pulakos (Eds.), The changing nature of work performance: Implications for staffing, personnel actions, and

development (pp. 240-292). San Francisco: Jossey-Bass.

Kozlowski, S. W. J., Gully, S. M., Salas, E., & Cannon-Bowers, J. A. (1996b). Team leadership and development: Theory, principles, and guidelines for training leaders and teams. In M. Beyerlein, D. Johnson, & S. Beyerlein (Eds.), Advances in interdisciplinary studies of work teams: Team leadership (Vol. 3, pp. 251-289).

Kozlowski, S. W., & Hattrup, K. (1992). A disagreement about within-group agreement: Disentangling issues of consistency versus consensus. *Journal of Applied Psychology, 77*(2), 161–167. https://doi.org/10.1037/0021-9010.77.2.161

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners.* Sage Publications Limited.

Lacity, M. C. & Janson, M. A. (1994). Understanding qualitative data: A framework of text analysis methods. Journal of Management Information Systems, 11(2), 137–155. https://doi.org/10.1080/07421222.1994.11518043

Lambert, J., Chapman, J., & Lurie, D. (2013). Challenges to the four-channel model of flow: Primary assumption of flow support the moderate challenging control channel. The Journal of Positive Psychology, 8(5), 395-403.

Landhäußer, A., & Keller, J. (2012). Flow and its affective, cognitive, and performance-related consequences. In Advances in flow research (pp. 65-85). Springer, New York, NY.

Langfred, C. W. 2004. Too much of a good thing? Negative effects of high trust and individual autonomy in self- managing teams. Academy of Management Journal, 47: 385-399. https://doi.org/10.1023/A:1009826304308

Larson, L. M., & Daniels, J. A. (1998). Review of the counseling self-efficacy literature. The Counseling Psychologist, 26(2), 179-218.

Larson, R., & Richards, M. H. (1994). Divergent realities: The emotional lives of mothers, fathers, and adolescents. New York: Basic Books.

LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational research methods, 11*(4), 815-852. https://doi.org/10.1177%2F1094428106296642

LeBreton, J. M., Burgess, J. R., Kaiser, R. B., Atchley, E. K., & James, L. R. (2003). The restriction of variance hypothesis and interrater reliability and agreement: Are ratings from multiple sources really dissimilar?. *Organizational*

Research Methods, *6*(1), 80-128. https://doi.org/10.1177%2F1094428102239427

Leech, N. L. & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. Quality and Quantity, 43(2), 265–275. https://doi.org/10.1007/s11135- 007-9105-3

LeFevre, J. (1988). Flow and the quality of experience during work and leisure.

Lewin, K. (1952). "Group decision and social change". In *Readings in social psychology*, Edited by: Swanson, GE, Newcomb, TM and Harley, EL. 459–473. New York: Holt.

Lewis, R. (1995). Editorial: Professional learning. *Journal of Computer Assisted Learning,* 11, 193-195.

Lewin, R., & Regine, B. (2000). Weaving complexity and business: Engaging the soul at work. New York: Texere.

Lindsley, D. H., Brass, D. J., & Thomas, J. B. (1995). Efficacy-performing spirals: A multilevel perspective. *Academy of management review*, *20*(3), 645-678.

Lomax, R. G., & Schumacker, R. E. (2004). *A beginner's guide to structural equation modeling*. psychology press.

Luszczynska, A. & Schwarzer, R. (2005). "Social cognitive theory". In M. Conner & P. Norman (eds.). *Predicting health behaviour* (2nd ed. rev. ed.). Buckingham, England: Open University Press. pp. 127–169.

Luszczynska, A., & Schwarzer, R. (2005). Social cognitive theory. Predicting Health Behaviour, 2, 127-169.

Mack, N., Woodsong, C., MacQueen, K., Guest, G., & Namey, E. (2005). Qualitative Research Methods: A Data Collector's Field Guide. Online.

MacKinnon, D. P., & Luecken, L. J. (2008). How and for whom? Mediation and moderation in health psychology. *Health Psychology, 27*(2, Suppl), S99–S100. https://doi.org/10.1037/0278-6133.27.2(Suppl.).S99

Mäkikangas, A., Bakker, A. B., Aunola, K., & Demerouti, E. (2010). Job resources and flow at work: Modelling the relationship via latent growth curve and mixture model methodology. *Journal of Occupational and Organizational Psychology*, *83*(3), 795-814.

Mäkikangas, A., Feldt, T., Kinnunen, U., & Tolvanen, A. (2012). Do low burnout and high work engagement always go hand in hand? Investigation of the

energy and identification dimensions in longitudinal data. *Anxiety, Stress & Coping*, *25*(1), 93-116.

Marks, M. A. (1999). A test of the impact of collective efficacy in routine and novel performance environments. *Human Performance*, *12*(3-4), 295-309.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. Academy of management review, 26(3), 356-376.

Massimini, F., & Carli, M. (1988). Systematic assessment of flow in daily experience. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), Optimal experience: Psychological studies of flow in consciousness (pp. 266–287). Cambridge, UK: Cambridge University Press.

Mathieu, J. E., & Gilson, L. L. (2012). Criteria issues and team effectiveness. In The Oxford Handbook of Organizational Psychology, Volume 2.

Mathieu, J. E., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future. Journal of Management, 34, 410-476.

McAlister AL, Perry CL, Parcel GS (2008). "How Individuals, Environments, and Health Behaviors Interact: Social Cognitive Theory". Health Behavior and Health Education: Theory, Research, and Practice (4th ed.). San Francisco, CA: John Wiley & Sons, Inc. pp. 169–188.

McGrath, J. E. (1964). Social Psychology: A brief introduction. New York: Holt, Rinehart, & Winston.

McGrath, J. E., & Hollingshead, A. B. (1994). Groups interacting with technology. Thousand Oaks, CA: Sage Publications.

Menon, T., & Phillips, K. W. (2011). Getting even or being at odds? Cohesion in even-and odd-sized small groups. Organization Science, 22(3), 738-753.

Merriam, S. B. (2002). Introduction to qualitative research. In S. B. Merriam (Ed.), Qualititative research in practice: Examples for discussion and analysis (pp. 1– 17). San Francisco CA: Wiley.

Minick, N. (1987). The development of Vygotsky's thought: An introduction. In *The collected works of LS Vygotsky* (pp. 17-36). Springer, Boston, MA.

Mirvis, P. H. (1996). Historical foundations of organization learning. *Journal of Organizational Change Management*, *9*(1), 13-31.

Mischel, L. J., & Northcraft, G. B. (1997). "I think we can, I think we can...": The

role of efficacy beliefs in group and team effectiveness. In B. Markovsky, M. J. Lovaglia, & L. Troyer (Eds.), Advances in group processes, Vol. 14 (p. 177–197). Elsevier Science/JAI Press.

Mokken, R. J. (2011). *A theory and procedure of scale analysis: With applications in political research* (Vol. 1). Walter de Gruyter.

Moneta, G. B., & Csikszentmihalyi, M. (1996). The effect of perceived challenges and skills on the quality of subjective experience. Journal of Personality, 64(2), 275–310.

Morgan, B. B., Salas, E., & Glickman, A. S. (1993). An analysis of team evolution and maturation. Journal of General Psychology, 120 (3), 277-291.

Morgeson, F. P., & Hofmann, D. A. (1999). The structure and function of collective constructs: Implications for multilevel research and theory development. Academy of Management Review, 24, 249–265.

Moritz, S. E., Feltz, D. L., Fahrbach, K. R., & Mack, D. E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. Research quarterly for exercise and sport, 71(3), 280-294

Morris, P. W., & Jamieson, A. (2005). Moving from corporate strategy to project strategy. *Project Management Journal*, *36*(4), 5-18. https://doi.org/10.1177%2F875697280503600402

Morse, J., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. International Journal of Qualitative Methods, 1(2), 13–22. https://doi.org/10.1177/160940690200100202

Murnighan, J. K., & Conlon, D. E. (1991). The dynamics of intense work groups: A study of British string quartets. Administrative science quarterly, 165-186.

Nakamura, J., & Csikszentmihalyi, M. (2009). Flow theory and research. In C. R. Snyder & S. J. Lopez, TheOxford handbook of positive psychology (2nd Ed.), (pp. 195-206). Oxford: Oxford University Press.

Nederhof, A. J. (1985). Methods of coping with social desirability bias: A review. European Journal of Social Psychology, 15(3), 263-280.

Newsom, J. T. (2012). Some clarifications and recommendations on fit indices. *USP*, *655*, 123-133.

Nielsen, K., & Cleal, B. (2010). Predicting flow at work: Investigating the activities and job characteristics that predict flow states at work. *Journal of*

Occupational Health Psychology, *15*(2), 180.

Nunnally, J. C. (1975). Psychometric theory—25 years ago and now. *Educational Researcher*, *4*(10), 7-21. https://doi.org/10.3102/0013189X004010007

Onwuegbuzie, A. J., & Collins, K. M. (2007). A typology of mixed methods sampling designs in social science research. *The qualitative report*, *12*(2), 281-316.

Onwuegbuzie, A. J. & Leech, N. L. (2006). Linking research questions to mixed methods data analysis. The Qualitative Report, 11(3), 474–498.

Pajares, F. (2003). Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature. Reading &Writing Quarterly, 19(2), 139-158.

Pearce, M., Rench, T. A., Braun, M. T., Baard, S. K., DeShon, R. P., & Kozlowski, S. W. J. (2012, April). Life on the ice: Examining cohesion dynamics in Antarctic search teams. In W. L. Bedwell & S. W. J. Kozlowski (Chairs), The sci- ence ofteams: Learning from the extremes. Sym- posium presented at the 27th Annual Conference of the Society for Industrial and Organizational Psychology, San Diego, CA.

Peñalver, J., Salanova, M., Martínez, I. M., & Schaufeli, W. B. (2019). Happy-productive groups: How positive affect links to performance through social resources. The Journal of Positive Psychology, 14(3), 377-392.

Pierce, J. R., & Aguinis, H. (2013). The too-much-of-a-good-thing effect in management. *Journal of Management*, *39*(2), 313-338. https://doi.org/10.1177%2F0149206311410060

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879- 903.

Preacher, K. J. (2015). Advances in mediation analysis: A survey and synthesis of new developments. *Annual review of psychology*, *66*, 825-852. https://doi.org/10.1146/annurev-psych-010814-015258

Preacher, & Leonardelli (2001, March) *Calculation for the Sobel test: An interactive calculation tool for mediation.* Retrieved from http://quantpsy.org/sobel/sobel.htm

Project Management Institute. (2013) Project Management Institute: A Guide to the Project Management Body of Knowledge (PMBOK Guide) (5th ed.),

PMI Publications, Newtown Square, PA.

Prussia, G. E., & Kinicki, A. J. (1996). A motivational investigation of group effectiveness using social-cognitive theory. *Journal of Applied Psychology, 81*(2), 187.

Quinn, R. W. (2005). Flow in knowledge work: High performance experience in the design of national security technology. Administrative Science Quarterly, 50(4), 610–641. doi:10.2189/asqu.50.4.610

Raettig, T., & Weger, U. (2018). Learning as a Shared Peak Experience: Interactive Flow in Higher Education. International Journal of Applied Positive Psychology, 2(1-3), 39-60.

Rapp, T. L., Bachrach, D. G., Rapp, A. A., & Mullins, R. (2014). The role of team goal monitoring in the curvilinear relationship between team efficacy and team performance. *Journal of Applied Psychology, 99*(5), 976–987. https://doi.org/10.1037/a0036978

Rodriguez-Sanchez, A. M., Cifre, E., Salanova Soria, M., & Åborg, C. (2008). Technoflow among Spanish and Swedish students: A confirmatory factor multigroup analysis. *Anales de Psicolog´ıa, 24*, 42–48.

Rodríguez-Sánchez, A., Salanova, M., Cifre, E., & Schaufeli, W. B. (2011). When good is good: A virtuous circle of self-efficacy and flow at work among teachers. *Revista de Psicología Social, 26*(3), 427-441.

Rodríguez-Sánchez, A. M., Schaufeli, W., Salanova, M., Cifre, E., & Sonnenschein, M. (2011). Enjoyment and absorption: An electronic diary study on daily flow patterns. *Work & Stress, 25*(1), 75-92.

Rowley, J. (2012). Conducting research interviews. Management Research Review, 35(3/4), 260–271. https://doi.org/10.1108/01409171211210154

Russell, W. (2001). An examination of flow state occurrence in college athletes. Journal of Sport Behaviour, 24(1), 83–107.

Sadri, G., & Robertson, I. T. (1993). Self-efficacy and work-related behaviour: a review and meta-analysis. Applied Psychology, 42(2), 139-152.

Salanova, M., Bakker, A., & Llorens, S. (2006). Flow at Work: Evidence for an Upward Spiral of Personal and Organizational Resources. Journal of Happiness Studies, 7, 1–22.

Salanova, M., Llorens, S., Cifre, E., Mart´ınez, I. M., & Schaufeli, W. B. (2003). Perceived collective efficacy, subjective well-being and task performance

among electronic work groups: An experimental study. Small Groups Research, 34, 43–73.

Salanova, M., Rodríguez-Sánchez, A. M., Schaufeli, W. B., & Cifre, E. (2014). Flowing together: A longitudinal study of collective efficacy and collective flow among workgroups. The Journal of Psychology, 148(4), 435-455.

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an understanding of team performance and training. In R. W. Swezey & E. Salas (Eds.), Teams: Their training and performance (pp. 3-29). Norwood, NJ: Ablex.

Sale, J. E. M., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. Quality and Quantity, 36(1), 43–53. https://doi.org/10.1023/A:1014301607592

Sato, I. (1988). Bosozoku: Flow in Japanese motorcycle gangs. In M. Csikszentmihalyi, I. Csikszentmihalyi (Ed.), Optimal experience: Psychological studies of flow in consciousness (pp. 92–117). Cambridge, UK: Cambridge University Press.

Sawyer, R. K. (2007). Group genius: The creative power of collaboration . New York: Basic Books.

Sawyer, R. K. (2014). Group creativity: Music, theater, collaboration. Psychology Press.

Sawyer, R. K., & DeZutter, S. (2009). Distributed creativity: How collective creations emerge from collaboration. Psychology of Aesthetics, Creativity, and the Arts, 3(2), 81–92. https://doi.org/10.1037/a0013282

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. Journal of Educational Research, 99(6), 323–338. https://doi.org/10.3200/JOER.99.6.323-338

Schriesheim, C. A., Powers, K. J., Scandura, T. A., Gardiner, C. C., & Lankau, M. J. (1993). Improving construct measurement in management research: Comments and a quantitative approach for assessing the theoretical content adequacy of paper-and- pencil survey-type instruments. Journal ofManagement, 19, 385–417

Schwarzer, R. (1999). General perceived self-efficacy in 14 cultures. *Self-Self-Efficacy assessment, http://www. yorku. ca/faculty/academic/schwarz.*

e/world14. htm.

Sijtsma, K. & Hemker, B.T. Psychometrika (1998) 63: 183. https://doi.org/10.1007/BF02294774

Sijtsma, K., & Junker, B. W. (1996). A survey of theory and methods of invariant item ordering. *British Journal of Mathematical and Statistical Psychology*, *49*(1), 79-105. https://doi.org/10.1111/j.2044-8317.1996.tb01076.x

Sijtsma, K., & Molenaar, I. W. (2002). *Introduction to nonparametric item response theory* (Vol. 5). Sage.

Sijtsma, K., & van der Ark, L. A. (2017). A tutorial on how to do a Mokken scale analysis on your test and questionnaire data. *British Journal of Mathematical and Statistical Psychology*, *70*(1), 137-158. https://doi.org/10.1111/bmsp.12078

Slavec, A., & Drnovsek, M. (2012). A perspective on scale development in entrepreneurship research. Economic and Business Review, 14,39–62.

Smith, J. & Firth, J. (2011). Qualitative data analysis: The framework approach. Nurse Researcher, 18(2), 52–63. https://doi.org/10.7748/nr2011.01.18.2.52.c8284

Snow, K. Y. (2010). Work relationships that flow: Examining the interpersonal flow experience, knowledge sharing, and organizational commitment. Ann Arbor: The claremont graduate university.

Spender, J. C. (1996). Organizational knowledge, learning and memory: three concepts in search of a theory. *Journal of organizational change management*, *9*(1), 63-78.

Spreitzer, G. M., Quinn, R. E., & Fletcher, J. (1995). Excavating the paths of meaning, renewal, and empowerment: A typology of managerial high-performance myths. *Journal of Management Inquiry*, *4*(1), 16-39.

Stajkovic, A. D., Lee, D., & Nyberg, A. J. (2009). Collective efficacy, group potency, and group performance: Meta-analyses of their relationships, and test of a mediation model. *Journal of applied psychology*, *94*(3), 814.

Stansfeld, S., & Candy, B. (2006). Psychosocial work environment and mental health-a meta-analytic review. Scandinavian Journal of Work, Environment & Health, 443-462.

Stephens, N. (2007). Collecting data from elites and ultra elites: Telephone and

face-to-face interviews with macroeconomists. Qualitative Research, 7(2), 203–216. https://doi.org/10.1177/1468794107076020

Sundstrom, E., McIntyre, M., Halfhill, T., & Richards, H. (2000). Work groups from the Hawthorne studies to work teams of the 1990's and beyond. Group Dynamics: Theory, Research, and Practice, 4, 44-67.

Tasa, K., Taggar, S., & Seijts, G. H. (2007). The development of collective efficacy in teams: a multilevel and longitudinal perspective. *Journal of Applied Psychology*, *92*(1), 17.

Tashakkori, A. & Teddlie, C. (Eds.) (2003). Handbook of mixed methods in social & behavioral research (1st ed.). Thousand Oaks (CA): SAGE Publications.

Tenenbaum, G., Fogarty, G. J., & Jackson, S. A. (1999). The flow experience: a Rasch analysis of Jackson's Flow State Scale. Journal of Outcome Measurement, 3(3), 278-294.

Theorell, T. (2007). Psychosocial factors in research on work conditions and health in Sweden. Scandinavian Journal of Work, Environment & Health, 20-26.

Tuckett, A. G. (2005). Applying thematic analysis theory to practice: A researcher's experience. Contemporary Nurse, 19(1–2), 75–87. https://doi.org/10.5172/conu.19.1-2.75

Tuckman, B. W. (1965). Developmental sequence in small groups. Psychological Bulletin, 63, 384-399.

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. Review of educational research, 78(4), 751-796.

Van den Hout, J. J., Davis, O. C., & Walrave, B. (2016). The application of team flow theory. In Flow experience (pp. 233-247). Springer, Cham.

Van der Ark, L. A., & Bergsma, W. P. (2010). A note on stochastic ordering of the latent trait using the sum of polytomous item scores. *Psychometrika*, *75*(2), 272-279. https://doi.org/10.1007/s11336-010-9147-7

van der Eijk (2018). Structural Equation Models-2 Beyond the 'helicopter' view. [PowerPoint slides].

Van der Eijk, C., & Rose, J. (2015). Risky business: factor analysis of survey data–

assessing the probability of incorrect dimensionalisation. PloS one, 10(3), e0118900.

Van der Vegt, G. S., De Jong, S. B., Bunderson, J. S., & Molleman, E. (2010). Power asymmetry and learning in teams: The moderating role of performance feedback. Organization Science, 21(2), 347-361.

Van Schuur, W. H. (2011). *Ordinal item response theory: Mokken scale analysis* (Vol. 169). Sage.

Varela, F. J. (1999). Ethical know-how: action, wisdom, and cognition. Stanford, CA: Stanford University Press.

Vittersø, J. (2004). Subjective well-being versus self-actualization: Using the flow-simplex to promote a conceptual clarification of subjective quality of life. *Social Indicators Research*, *65*(3), 299-331.

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Cole, M., V. John-Steiner, S. Scribner, and E. Souberman, eds. Cambridge, MA: Harvard University Press.

Wageman, R., Gardner, H., & Mortensen, M. (2012). The changing ecology of teams: New directions for teams research. *Journal of Organizational Behavior*, *33*(3), 301-315. https://doi.org/10.1002/job.1775

Walker, C. J. (2010). Experiencing flow: Is doing it together better than doing it alone?. *The Journal of Positive Psychology*, *5*(1), 3-11.

Watson, C. B., Chemers, M. M., & Preiser, N. (2001). Collective efficacy: A multilevel analysis. Personality and social psychology bulletin, 27(8), 1057-1068.

Weaver, W. (1948). Science and complexity. American Scientist 36, 536-544. (Available at http://www.ceptualinstitute.comlgenre/weaver/weaver- 1947b

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. *New Directions for Child and Adolescent Development*, *1984*(23), 7-18.

Whiteoak, J. W. (2014). The dynamic relationship among group efficacy perceptions, attributions and task performance. E-Journal of Social & Behavioral Research in Business, 5(1), 7–22.

Whitney, K. (1994). Improving group task performance: The role of group goals and group efficacy. *Human performance*, *7*(1), 55-78.

Winter, G. (2000). A comparative discussion of the notion of "validity" in

qualitative and quantitative research. The Qualitative Report, 4(3), 1–14.

World Bank. (2012). *The World Bank Annual Report 2012*. The World Bank.

Wright, T. A., Quick, J. C., Hannah, S. T., & Blake Hargrove, M. (2017). Best practice recommendations for scale construction in organizational research: The development and initial validation of the Character Strength Inventory (CSI). Journal of organizational Behavior, 38(5), 615-628.

Wrzesniewski, A., & Dutton, J. E. (2001). Crafting a job: Revisioning employees as active crafters of their work. *Academy of management review*, *26*(2), 179-201.

Zaccaro, S. J., Blair, V., Peterson, C., & Zazanis, M. (1995). Collective efficacy. In *Self-efficacy, adaptation, and adjustment* (pp. 305-328). Springer, Boston,

APPENDIX

The following documents are provided in the appendix:

- Appendix A: Participant information sheet and consent form of Study 1
- Appendix B: Study 2 Participant information sheet, consent form and the questionnaire
- Appendix C Participant information sheet, consent form and Study 3 and 4 Questionnaire
- Appendix D: Ethics Approval letter with the corrections
- Appendix E: Factor analysis of CZPD

Further documents/supporting information can be provided on request.

Appendix A: Participant information sheet and consent form of Study 1



University of Nottingham, School of Medicine, Division of Psychiatry and Applied Psychology

Title of Project: team collaboration structure and its association with team flow and team efficacy

Name of Investigators: Weiwei Wang and Dr Angeli Santos

Faculty of Medicine and Health Sciences Research Ethics Ref: LT08022016 SoM PAP

Healthy Volunteer's Information Sheet

(In-depth interview)

Version dated 8th Dec 2016

You have been invited to take part in a research study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives if you wish to. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part or not. If you decide to take part you may keep this leaflet. Thank you for reading this.

Background of the study

The focus of this study is to explore the collaboration structure of project teams and its association with peak performance experience and member's confidence in their team's capability. Specifically, this study looks into the relationship between patterns of group interaction (e.g. depth of discussion over a certain topic, equal participation of members into the discussion etc.) and team performance.

Aims of the study

1. To explore the team collaboration structure in terms of member discussion, skill diversification shared knowledge base and team management structure.

2. To explore how this collaboration structure is related to the experience of team flow and team effectiveness.

Duration of the study

Approximately 30 minutes

What does the study involve?

You have been selected to speak with us today because you have been identified as someone who has a great deal to share about the experience of teamwork. Your participation in this study is expected to last for approximately 30 minutes. During this time, we have several questions that we would like to cover. If time begins to run short, it may be necessary to interrupt you in order to push ahead and complete this line of questioning. No travel expenses will be allocated to you, as there's no need for physical travelling of any kind. To facilitate note-taking, we would like to audiotape our conversations today. For your information, only researchers on the project will have access to the recordings, which will be destroyed after transcription is completed. Please sign the consent form. Essentially, this document states that: (1) all information will be held confidential, (2) your participation is voluntary and you may stop at any time if you feel uncomfortable, and (3) we do not intend to inflict any harm. Thank you for agreeing to participate.

Research methods of this study

This research will be using an in-depth interview. Thematic analysis technique will be employed to analyse your interview responses.

Why have you been chosen?

You are chosen for this study because you meet the entry criteria: you are a member of a group project that requires long-term interaction with other group members and the performance outcome is dependent on team collaboration.

Do you have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

What do you have to do?

You are not required to act any differently during your participation in this study except for filling out the questionnaire.

What are the possible disadvantages and risks of taking part?

We don't expect there to be any disadvantages or risks to taking part. In the unlikely event that it does give rise to any concerns for you, we advise you to contact the counselling center in the university. The University of Nottingham counselling service provides free service to the student and help with a range of emotional and psychological issues. You can content them via its website (www.nottingham.ac.uk/counselling) or email (counselling.service@nottingham.ac.uk).

What if something goes wrong? / Who can I complain to.

In case you have a complaint on your treatment by a member of the researchers or anything to do with the study, you can initially approach the lead investigator. If you remain unhappy and wish to complain formally, you should then contact the FMHS Research Ethics Committee Administrator, c/o The University of Nottingham, Faculty PVC Office, B Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, Nottingham, NG7 2UH. E-mail: FMHS-ResearchEthics@nottingham.ac.uk

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept on a password-protected database and is strictly confidential. Any information about you which leaves the leading researcher will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The results of the study will contribute towards a postgraduate degree (i.e. PhD). It is expected that the results will also be published in scientific journals and presented at conferences. The published result of this study can be obtained from the leading researcher. You can also require the leading researcher to feedback on the results that is relevant to you. You will not be identified in any report or publication.

Who is organising the research?

This research is organised by the School of Medicine, Division of Psychiatry and Applied Psychology from the University of Nottingham. The project will not receive funding.

Who has reviewed the study?

This study has been reviewed and approved by the University of Nottingham Medical School Ethics Committee.

Contact details:

Weiwei Wang

School of Medicine

Division of Psychiatry and Applied Psychology

Tel: 07762304594

E-mail: msxww2@nottingham.ac.uk

Dr Angeli Santos

School of Medicine

Division of Psychiatry and Applied Psychology

Tel: 01158466639

Email: angeli.santos@nottingham.ac.uk

Thank you for volunteering in taking part in this study. You will be given a copy of this information sheet and a signed consent form to keep.

University of Nottingham

School of Medicine

Division of Psychiatry and Applied Psychology

Title of Project: team collaboration structure and its association with team flow and team efficacy

Name of Investigators: Weiwei Wang Dr Angeli Santos

Faculty of Medicine and Health Sciences Research Ethics Ref: LT08022016 SoM PAP

Healthy Volunteer's Consent Form

(In-depth interview)

Version dated 8th Dec 2016

Please read this form and sign it once the above named or their designated representative, has explained fully the aims and procedures of the study to you

- I voluntarily agree to take part in this study.
- I confirm that I have been given a full explanation by the above named and that I have read and understood the information sheet given to me which is attached.
- I voluntarily agree to be interviewed on the experience of my group project meetings.
- I have been given the opportunity to ask questions and discuss the study with one of the above investigators or their deputies on all aspects of the study and have understood the advice and information given as a result.
- I agree to the above investigators contacting my general practitioner [and teaching or university authority if appropriate] to make known my participation in the study where relevant.
- I agree to comply with the reasonable instructions of the supervising investigator and will notify him/her immediately of any unexpected unusual symptoms or deterioration of health.
- I authorise the investigators to disclose the results of my participation in the study but not my name.
- I understand that information about me recorded during the study will be kept in a secure database. If data is transferred to others it will be made anonymous. Data will be kept for 7 years after the results of this study have been published.
- I understand that relevant sections of my data collected in the study may be looked at by the research group and by other responsible individuals for monitoring and audit purposes. I give permission for these individuals to have access to these records and to collect, store, analyse and publish information obtained from my participation in this study. I understand that my personal details will be kept confidential.
- I understand that the interview will be audio recorded using a digital device and that anonymous direct quotes from the interview may be used in the study reports.

- I understand that I can ask for further instructions or explanations at any time.
- I understand that I am free to withdraw from the study at any time, without having to give a reason for withdrawing.
- I confirm that I have disclosed relevant medical information before the study.

Name: .....

Signature: ..... Date: .....

I confirm that I have fully explained the purpose of the study and what is involved to:

.....

I have given the above named a copy of this form together with the information sheet.

Investigators Signature: ..... Date: .....

Investigators Name: Weiwei Wang and Dr Angeli Santos

Study Number: ..... **Volunteer**

Appendix B: Study 2 Participant information sheet, consent form and the questionnaire



Information and Consent page for Online Survey/Questionnaire

Division of Psychiatry and Applied Psychology
B14 YANG Fujia Building
University of Nottingham
Jubilee Campus
Wollaton Road
Nottingham
NG8 1BB

Information sheet: a pilot study of the zone of proximal development (CZPD) questionnaire

Faculty of Medicine and Health Sciences Research Ethics Ref: LT08022016 SoM PAP

You are being invited to participate in this pilot study because you are aged 18-65 and you are currently undertaking a job that involves group/teamwork or that your last group/teamwork was no longer than twelve months ago. This study is being conducted by Weiwei Wang, a PhD student from the University of Nottingham. The information from this study will help develop the questionnaire of the zone of proximal development (CZPD) which is a measure designed to investigate the collaboration structure of project teams in the occupational settings.

The questionnaire will take approximately 15 minutes to complete. Your participation in this study is entirely voluntary and you can withdraw at any time by clicking the browser exit button. The data will only be uploaded on completion of the questionnaire by clicking the SUBMIT button. You are free to omit any questions if you wish.

We believe there are no known risks associated with this research study. As with any online related activity, the risk of a breach is always possible, we will, therefore, do everything possible to ensure your answers in this study will remain anonymous. We will minimize any risks by restricting any third-party access to the raw data, which will be destroyed by the end of the academic year.

We don't expect there to be any disadvantages or risks to taking part. In the unlikely event that it does give rise to any concerns for you, we advise you to contact the counselling center in the university. The University of Nottingham counselling service provides free service to the student and help with a range of emotional and psychological issues. You can content them via its website (www.nottingham.ac.uk/counselling) or email (counselling.service@nottingham.ac.uk).

The results of the study may be published in scientific journals and presented at scientific conferences. The data will be reported anonymously, with any identifying information removed.

If you have any questions about this project, you may contact the Lead Researcher Weiwei Wang or if you have any concerns about any aspect of this study please contact the Principal Research Supervisor: Dr Angeli Santos. If this does not achieve a satisfactory outcome please contact: FMHS Research Ethics Committee Administrator, c/o The University of Nottingham, School of Medicine Education Centre, B Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, Nottingham, NG7 2UH. E-mail: louise.sabir@nottingham.ac.uk.

This study has been reviewed and given a favorable opinion by the University of Nottingham, Faculty of Medicine & Health Sciences Research Ethics Committee [LT08022016 SoM PAP].

I have read and understood the above information and consent form, I confirm that I am 18 years old or older and by clicking the NEXT button to begin

the online questionnaire, I indicate my willingness to voluntarily take part in the study.

NEXT – I consent to take part EXIT - I do not give consent

(On a separate page)

Consent form: The emergence and impact of group-flow on team performance

Division of Psychiatry and Applied Psychology

Name of researchers: Weiwei Wang, Dr Angeli Santos

Faculty of Medicine and Health Sciences Research Ethics Ref: LT08022016 SoM PAP

Thank you for participating!

Please, tick each box to continue:

- O I confirm that I have read and understood the information on the previous page
- O I understand that my participation is voluntary and I can end the study at any time and withdraw my data by clicking the EXIT button.
- O I understand that my answers will be anonymous.
- O I understand the overall anonymized data from this study may be used in the future for research (with research ethics approval) and teaching purposes.

NEXT – to be taken to the survey.

Part 1 Demographic information

Age:

Gender:

Nationality:

What industry are you working in?

Part 2. Questionnaire

Reflecting on your teamwork scenarios, for example, having a **brainstorming session, or trying to make a decision etc.**, please indicate how often the following situations occur **on your current team**. (1 = never, 2 = almost never, 3 = sometimes, 4 = regularly, 5 = often, 6 = very often, 7 = always)		Never	Almost never	Sometimes	Regularly	Often	Very often	Always
1	When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation).	1	2	3	4	5	6	7
2	When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas.	1	2	3	4	5	6	7
3	When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement.	1	2	3	4	5	6	7
4	When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.	1	2	3	4	5	6	7
5	When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.	1	2	3	4	5	6	7
6	When discussing a specific problem, a resolution to the problem is reached by combining each other's ideas.	1	2	3	4	5	6	7

	Think about the development processes of your team project as a whole, please rate the degree to which each statement applies to **your current team**. (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree).	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
7	One or a few member(s) take a directive role in your team.	1	2	3	4	5	6	7
8	The development of your team project followed a pre-determined set of action plans or procedures. (e.g. planning, etc.)	1	2	3	4	5	6	7
9	The development of your team project strictly follows an approach decided by one or a few members.	1	2	3	4	5	6	7
10	Members have the freedom to influence the end-product.	1	2	3	4	5	6	7
11	There are only one or a few members of your team with the authority to decide on the way to carry out your project.	1	2	3	4	5	6	7
12	The end-product of your team project was predictable before it began.	1	2	3	4	5	6	7
13	A more knowledgeable and skilled member took a leading role in carrying out the project.	1	2	3	4	5	6	7
14	The quality of the project would suffer without the contribution of one or a few members who are more knowledgeable and skilled.	1	2	3	4	5	6	7
15	The development of your team project unfolds on its own.	1	2	3	4	5	6	7
16	The standards of quality for your team project develop over time.	1	2	3	4	5	6	7
17	All team members collectively decide on the way to carry out this project.	1	2	3	4	5	6	7
18	The end-product of your team project is the outcome of a collective decision-making process among team members.	1	2	3	4	5	6	7
19	The end-product of your team project is mostly influenced by requirements from outside the team (e.g. clients' requirement, industry regulation etc.).	1	2	3	4	5	6	7
20	Members have the freedom to influence the end-product.	1	2	3	4	5	6	7
21	Team members are equally skilled peers.	1	2	3	4	5	6	7
22	Attention and activities of the team are centred on the development of the end-product.	1	2	3	4	5	6	7
23	Members' roles are self-assigned.	1	2	3	4	5	6	7

24	Members' roles are imposed.	1	2	3	4	5	6	7
25	Members stick to the same roles throughout the project.	1	2	3	4	5	6	7
26	Members are free to take on different roles under different circumstances.	1	2	3	4	5	6	7
27	Members contribute ideas and/or suggestions voluntarily.	1	2	3	4	5	6	7
28	Individual contributions add to the diversity of ideas within the team.	1	2	3	4	5	6	7
29	Members of my team are diverse in terms of our ranges of interests.	1	2	3	4	5	6	7
30	Members of my team are diverse in terms of our ranges of expertise.	1	2	3	4	5	6	7
31	The end-product of the project benefits from members' diversified skills and expertise.	1	2	3	4	5	6	7
32	The team has a clear overall objective that all members know in advance. (e.g., the team knows what is to be delivered in the end.)	1	2	3	4	5	6	7
33	Members share a set of standards for how a task should be conducted.	1	2	3	4	5	6	7
34	The requirements of the project are sufficiently specific.	1	2	3	4	5	6	7
35	The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry specific language and terminologies, jargons, etc.).	1	2	3	4	5	6	7
36	Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.)	1	2	3	4	5	6	7
37	All members have clearly defined responsibilities.	1	2	3	4	5	6	7
38	If one member is unable to accomplish the allocated task, other members are able to finish it instead.	1	2	3	4	5	6	7
39	Your team was established with a clearly defined task.	1	2	3	4	5	6	7
40	Your team was established with a broadly defined task.	1	2	3	4	5	6	7
41	The nature of the task allows for freedom to explore new options.	1	2	3	4	5	6	7
42	The nature of the task leaves us little space for experimentation.	1	2	3	4	5	6	7
43	The project development is an iterative process to obtain greater details and accuracy of the solution.	1	2	3	4	5	6	7

Appendix C: Participant information sheet, consent form and Study 3 and 4 Questionnaire

Teamwork survey

The University of Nottingham, School of Medicine, Division of Psychiatry and Applied Psychology

Title of Project: Team flow and effectiveness

Name of Investigators: Weiwei Wang, Dr Angeli Santos

Part 1. Information sheet

You are being invited to participate in a research study if you are **aged 18** and above and you are currently undertaking a task that involves **team collaboration/work.**

The **purpose** of this research is to investigate the potential impact of teamwork organisation on team effectiveness and teamwork experience. This study is being conducted by Weiwei Wang, a PhD researcher from the Division of Psychiatry and Applied Psychology, Medical School, University of Nottingham.

It will take you approximately 20 minutes to complete this survey. Your participation in this study is **entirely** voluntary and you can withdraw and you don't need to give a reason.

We believe there are no known risks associated with this research study. We will minimize any risks by restricting any third-party access to the raw data, which will be destroyed as soon as data analysis is completed. The results of the study may be published in scientific journals and presented at scientific conferences. The result will be reported **anonymously**, with any identifiable information removed.

If you have any questions about this project, you may contact the Lead Researcher Weiwei Wang or if you have any concerns about any aspect of this study please contact the Principal Research Supervisor: Dr Angeli Santos at angeli.santos@nottingham.ac.uk. If you remain unhappy and wish to complain formally, you should then contact the FMHS Research Ethics Committee

Administrator, c/o The University of Nottingham, Faculty PVC Office, B Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, Nottingham, NG7 2UH. E-mail: FMHS-ResearchEthics@nottingham.ac.uk

We do not expect there to be any disadvantages or risks to taking part. In the unlikely event that it does give rise to any concerns for you, we advise you to contact the counselling centre in the university. The University of Nottingham counselling service provides free service to the student and help with a range of emotional and psychological issues. You can content them via its website (www.nottingham.ac.uk/counselling) or email (counselling.service@nottingham.ac.uk).

This study has been reviewed and given a favourable opinion by the University of Nottingham, Faculty of Medicine & Health Sciences Research Ethics Committee.

Part 2. Consent form

The University of Nottingham, School of Medicine, Division of Psychiatry and Applied Psychology

Title of Project: Team flow and effectiveness

Names of Investigators: Weiwei Wang, Dr Angeli Santos

Healthy Volunteer's Consent Form

Please read this form and sign it once the above named or their designated representative, has explained fully the aims and procedures of the study to you

- I voluntarily agree to take part in this study.
- I confirm that I have been given a full explanation by the above named and that I have read and understood the information sheet given to me which is attached.
- I have been given the opportunity to ask questions and discuss the study with one of the above investigators or their deputies on all aspects of the study and have understood the advice and information given as a result.
- I agree with the above investigators contacting my general practitioner [and teaching or university authority if appropriate] to make known my participation in the study where relevant.
- I agree to comply with the reasonable instructions of the supervising investigator and will notify him/her immediately of any unexpected unusual symptoms or deterioration of health.
- I authorise the investigators to disclose the results of my participation in the study but not my name.
- I understand that information about me recorded during the study will be kept in a secure database. If data is transferred to others it will be made anonymous. Data will be kept for 7 years after the results of this study have been published.
- I understand that I can ask for further instructions or explanations at any time.
- I understand that I am free to withdraw from the study at any time, without having to give a reason for withdrawing.

- I confirm that I have disclosed relevant medical information before the study.

Signature: ..... Date: .....

I confirm that I have fully explained the purpose of the study and what is involved to the above named and have also given him/her a copy of the information sheet.

Investigators Signature: .... Weiwei Wang**.....**

Investigators' Name: Weiwei Wang, Dr. Angeli Santos

Part 3. Response-matching information

As you have been invited to fill in this questionnaire at the beginning of your team task, the information obtained from the following questions will help us match your responses and track the possible changes occurred during the task. This information will **NOT** be used to identify your responses.

a. Please help us match your own participant number using your date of birth, for example, if you were born on the 20th of January 1993, please state 200193.

D	D	M	M	Y	Y

b. Please tell us the code of the team you belong to, for example, team C.

.....

c. Please tell us how many members are there on your team?

.....

d. Please indicate on the spectrum where you are in terms of your team task progress.

1 **We've just started**	2	3	4 **We are in the middle of the team task**	5	6	7 **We have already finished**

Part 4. Demographic information

Age:

Gender:

Nationality:

Part 5. Questionnaire

a. **Task nature**

	Problem-solving is referred to as a product-oriented task. This type of task has a known and specific goal, for example, a known flaw that needs to be fixed. **Problem exploration** is referred to as a process-oriented task. This type of task only has a broad requirement, for example, developing a business plan. Problem exploration is often required before the real problem could be identified.	Purely problem-solving			A fairly even mixture of both			Purely problem-exploration
1	Please indicate on the spectrum, what best describes the nature of your team task.	1	2	3	4	5	6	7

b. **Team organisation**

Reflecting on your teamwork scenarios, for example, having a **brainstorming session, or trying to make a decision etc**., please indicate how often the following situations occur **on your current team**. (1 = never, 2 = almost never, 3 = sometimes, 4 = regularly, 5 = often, 6 = very often, 7 = always)		Never	Almost never	Sometimes	Regularly	Often	Very often	Always
1	When your team is working on a specific problem, members often make an effort to present their individual ideas to the team (e.g. by showing one's idea or work, talking about it or delivering a presentation).	1	2	3	4	5	6	7
2	When your team is working on a specific problem, members often engage in discussions to try to understand or analyse each other's ideas.	1	2	3	4	5	6	7
3	When your team is working on a specific problem, members often engage in discussion about each other's ideas to reach an agreement.	1	2	3	4	5	6	7
4	When your team is working on a specific problem, members often make an effort to compare and contrast each other's ideas to achieve a better understanding.	1	2	3	4	5	6	7
5	When your team is working on a specific problem, members treat disagreement as an opportunity to create new ideas.	1	2	3	4	5	6	7
6	When discussing a specific problem, a resolution to the problem is reached by combining each other's ideas.	1	2	3	4	5	6	7
	Think about the development processes of your team project as a whole, please rate the degree to which each statement applies to **your current team**. (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree).	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	There are only one or a few members of your team with the authority to decide on the way to carry out your project.	1	2	3	4	5	6	7

2	All team members collectively decide on the way to carry out this project.	1	2	3	4	5	6	7
3	The end-product of your team project is the outcome of a collective decision-making process among team members.	1	2	3	4	5	6	7
4	Members have the freedom to influence the end-product.	1	2	3	4	5	6	7
5	The nature of the task allows for freedom to explore new options.	1	2	3	4	5	6	7
6	The nature of the task leaves us little space for experimentation.	1	2	3	4	5	6	7
7	We gained a sense of ownership of the end product. (end-product: the outcome of the team task)	1	2	3	4	5	6	7
8	The development of your team project followed a pre-determined set of action plans or procedures. (e.g. planning, etc.)	1	2	3	4	5	6	7
9	The development of your team project strictly follows an approach decided by one or a few members.	1	2	3	4	5	6	7
10	There is only one way to carry out your team project.	1	2	3	4	5	6	7
11	Your team was established with a clearly defined task.	1	2	3	4	5	6	7
	Consider the roles that your team members have taken on, for example, **planning, testing suggestions, circulation of information, and resourcing for the project etc**. Please rate the degree to which each statement applies to **your current team.** (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree).	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	Members contribute ideas and/or suggestions voluntarily.	1	2	3	4	5	6	7
2	Attention and activities of the team are centred on the development of the end-product.	1	2	3	4	5	6	7
3	Individual contributions add to the diversity of ideas within the team.	1	2	3	4	5	6	7
4	Members of my team are diverse in terms of our ranges of interests.	1	2	3	4	5	6	7
5	Members of my team are diverse in terms of our ranges of expertise.	1	2	3	4	5	6	7
6	The end-product of the project is the outcome of a collective effort.	1	2	3	4	5	6	7

	Considering your team members background, for example, **their experience, expertise, competence, task-specific knowledge/skills** etc., please rate the degree to which each statement applies to **your current team.** (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree).	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	The team has a clear overall objective that all members know in advance. (e.g., the team knows what is to be delivered in the end.)	1	2	3	4	5	6	7
2	Members share a set of standards for how a task should be conducted.	1	2	3	4	5	6	7
3	The requirements of the project are sufficiently specific.	1	2	3	4	5	6	7
4	The members share a repertoire of explicit task-specific knowledge or skills that facilitate communication within the team (e.g. the ability to understand/ conduct business research like market research, industry-specific language and terminologies, jargons, etc.).	1	2	3	4	5	6	7
5	Members share an implicit understanding of the practices/rules that facilitate the interaction in the team (e.g., the ability to construct a convincing explanation, the ability to deliver a presentation, etc.)	1	2	3	4	5	6	7
6	All members have clearly defined responsibilities.	1	2	3	4	5	6	7

c. **Teamwork experience**

	The following statements refer to the way in which you experience working in the current team. Please **indicate how often** you experienced each of the statements. (1 = never, 2 = almost never, 3 = sometimes, 4 = regularly, 5 = often, 6 = very often, 7 = always).	Never	Almost never	Sometimes	Regularly	Often	Very often	Always
1	When my team is working on the project, we think about nothing else.	1	2	3	4	5	6	7

2	We get carried away by our work.	1	2	3	4	5	6	7
3	When my team is working on the project, we forget everything else around us.	1	2	3	4	5	6	7
4	We are totally immersed in our work.	1	2	3	4	5	6	7
5	Our work gives us a good feeling.	1	2	3	4	5	6	7
6	We do our work with a lot of enjoyment.	1	2	3	4	5	6	7
7	We feel happy during our work.	1	2	3	4	5	6	7
8	We feel cheerful when we are working.	1	2	3	4	5	6	7
9	We would still do this work even if it's not assessed.	1	2	3	4	5	6	7
10	We found that we also want to work on this project in our free time.	1	2	3	4	5	6	7
11	We work because we enjoy it.	1	2	3	4	5	6	7
12	When we are working on the project, we are doing it for ourselves.	1	2	3	4	5	6	7
13	We get our motivation from the work itself, and not from the reward of it.	1	2	3	4	5	6	7

d. **Perceived teamwork related competence**

	Please answer the following questions in relation to your experience of your team. Please indicate on the scales how often do the following feelings or thoughts occur. (1 = never, 2 = almost never, 3 = sometimes, 4 = regularly, 5 = often, 6 = very often, 7 = always)	Never	Almost never	Sometimes	Regularly	Often	Very often	Always
1	I feel confident about the capability of my team to perform the tasks very well.	1	2	3	4	5	6	7

2	My team is able to solve difficult tasks if we invest the necessary effort.	1	2	3	4	5	6	7
3	I feel confident that my group will be able to manage effectively unexpected troubles.	1	2	3	4	5	6	7
4	My group is totally competent to solve the task.	1	2	3	4	5	6	7

e. Task dependency

	The following statements refers to the way you and your team members work together, please indicate the degree to which each statement applies to your current team. (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree).	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	We worked as a team--not a collection of individuals with their own tasks to perform.	1	2	3	4	5	6	7
2	My work was not done until everyone had done his or her part.	1	2	3	4	5	6	7
3	We often had to share materials and ideas to get our work done.	1	2	3	4	5	6	7
4	In my team, we worked together a lot.	1	2	3	4	5	6	7
5	In my team we rarely needed to count on each other a lot.	1	2	3	4	5	6	7
6	I often had to talk to other people in my team in order to do my part well.	1	2	3	4	5	6	7

***f.* Team working conditions**

	Please answer the following questions in relation to your experience in your **current teamwork**. Please indicate on the scales **how often** do the following situations happen. (1 = never, 2 = almost never, 3 = sometimes, 4 = regularly, 5 = often, 6 = very often, 7 = always)	Never	Almost never	Sometimes	Regularly	Often	Very often	Always
1	We were challenged, but we believed our skills would allow us to meet the challenge.	1	2	3	4	5	6	7

2	Our ability matched the high challenge of the situation.	1	2	3	4	5	6	7
3	We felt we were competent enough to meet the high demands of the situation.	1	2	3	4	5	6	7
4	The challenge and our skills were at an equally high level.	1	2	3	4	5	6	7
5	We knew clearly what we wanted to do.	1	2	3	4	5	6	7
6	We had a strong sense of what we wanted to do.	1	2	3	4	5	6	7
7	We knew what we wanted to achieve.	1	2	3	4	5	6	7
8	Our goal was clearly defined.	1	2	3	4	5	6	7
9	It was really clear to us that we were doing well.	1	2	3	4	5	6	7
10	We were aware of how well we were performing.	1	2	3	4	5	6	7
11	We had a good idea about how we were doing while we were performing.	1	2	3	4	5	6	7
12	We could tell by the way we were performing how well we were doing.	1	2	3	4	5	6	7

This is the end of the survey, thanks very much for your participation and contribution.

Appendix D: Ethics Approval letter with the corrections

Direct line/e-mail
+44 (0) 115 8232561
Louise.Sabir@nottingham.ac.uk

Faculty of Medicine and Health Sciences

Research Ethics Committee
School of Medicine Education Centre
B Floor, Medical School
Queen's Medical Centre Campus
Nottingham University Hospitals
Nottingham
NG7 2UH

21st December 2016

WeiWei Wang
PhD Student
c/o Dr Phillip Leather
Reader in Occupational Psychology
Division of Psychiatry and Applied Psychology
Room B21 International House
Jubilee Campus
Wollaton Road
Nottingham
NG8 1BB

Dear WeiWei Wang

Ethics Reference No: LT08022016 SoM PAP **– please always quote**
Study Title: The emergence and impact of group-flow on performance on the team level.
Chief Investigator/Supervisor: Dr Phillip Leather, Reader in Occupational Psychology, Division of Psychiatry and Applied Psychology, School of Medicine.
Lead Investigators/student: WeiWei Wang, PhD Student, School of Medicine
Other Key Investigators/supervisors: Dr Angeli Santos, Associate Professor in Applied Psychology, Division of Psychiatry and Applied Psychiatry, Dr Suzanne Edinger Assistant Professor of Management, Stonehill College USA
Type of Study: online questionnaire, mixed quantitative and qualitative methods in-depth interview, non-participant observation, PhD project
Start Date: 1st March 2016
Amend start date: 1st February 2017 **Proposed End Date:** 1st June 2018 16 mths
No of Subjects: 320 **Age:** 18+ years

Thank you for notifying the Committee of amendment no 1: 09 December 2016 as detailed in the attached notice of amendment form and the following documents were received:

Short Title: group-flow

- Notice of amendment form dated 09 December 2016
- FMHS Research Ethics Application Form dated 06/12/2016
- Research Protocol version 1, 08/12/2016
- Online Questionnaire 08/12/2016

These have been reviewed and are satisfactory and amendment no 1 09 December 2016 is noted and approved.

Approval is given according to the following conditions:

1. You must follow the protocol agreed and inform the Committee of any changes using a notification of amendment form (please request a form).

2. You must notify the Chair of any serious or unexpected event.

3. This study is approved for the period of active recruitment requested. The Committee also provides a further 5 year approval for any necessary work to be performed on the study which may arise in the process of publication and peer review.

4. An End of Project Progress Report is completed and returned when the study has finished (Please request a form).

Yours sincerely



Professor Ravi Mahajan
Chair, Faculty of Medicine & Health Sciences Research Ethics Committee

Appendix E: Factor analysis CZPD

EFA (principal axis factoring) was firstly conducted on the data to explore the dimensionality of the 43-item pool. As is suggested by the Scree plot (see Figure E-1), after Oblique rotation, a four factor solution fits the data the best.

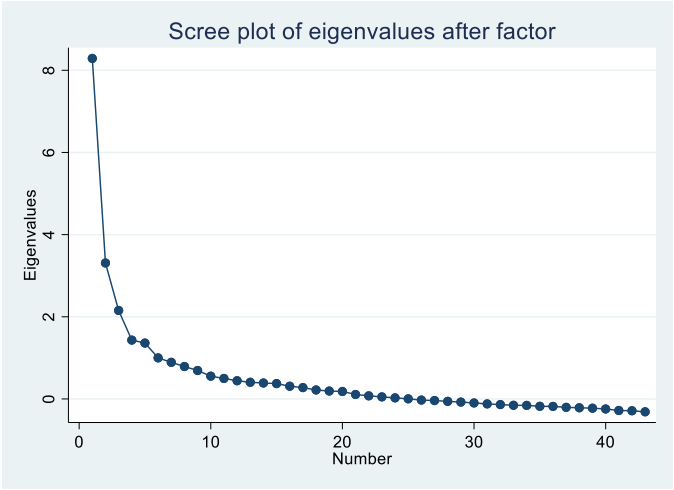


Figure E-1: Scree plot of the CZPD 43 item

A CFA based on the theory with five factor was conducted, however the estimation did not concave. Therefore, based on the EFA result, a second CFA using a four-factor solution was conducted.

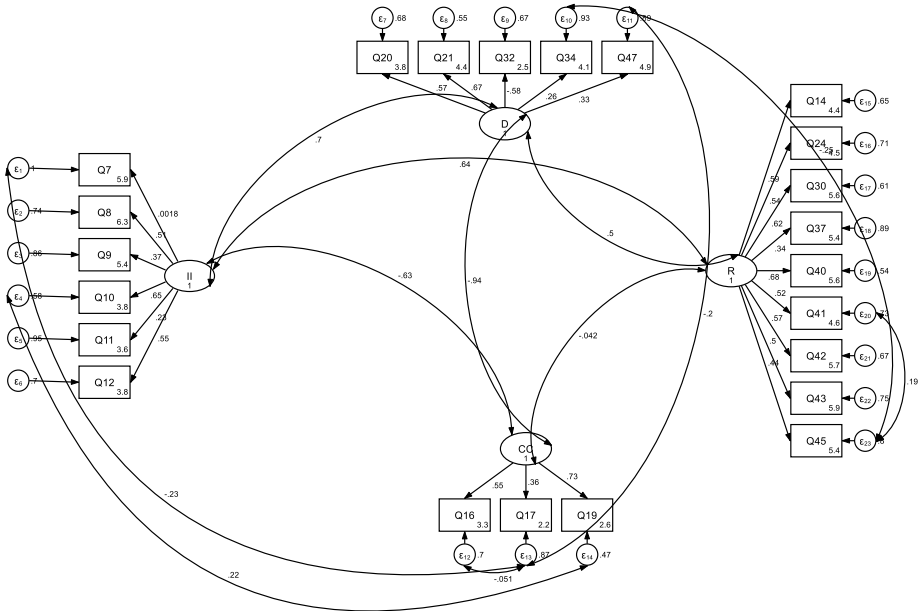


Figure E-2: CFA diagram with four dimensions.

As shown in Figure E-2, after an iterative process of modification, the $\chi 2$ test indicates that the model fit was not acceptable ($\chi 2$ (253) = 1760.67), SRMR=.179, CFI =1.00. As the model is not full rank, not report on RMSEA and TLI was produced. The four covariance cross dimensions suggest that there are common factors between the sub-dimensions that is not accounted for.