

Probabilities, delays and social distances: decision-making in different domains

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*Thesis submitted to the University of Nottingham for the
degree of Doctor of Philosophy*

SEPTEMBER 2016

Abstract

I start the thesis with a focusing model in which increasing the range of values of an attribute makes the decision-maker place more weight on this attribute. This model explains the documented communality between risky choice and intertemporal choice, and provides a unique explanation to the common ratio, common delay, and magnitude effects. It also captures preference reversals between choice and valuation, and different forms of context dependence such as the asymmetric dominance effect. Since the model is not restricted to probabilities and temporal delays, I also apply it to allocations characterised by an amount of money and a social distance. It predicts ‘common social distance’ effects, magnitude effects in the social domain, and preference reversals between choice and valuation of allocations.

I look for these social preference reversals in the second Chapter. I invite student subjects in the laboratory and isolate the effect of the social distance by comparing weak social distances, with allocations benefiting students in other Faculties, to strong social distances, where the allocations benefit widely different charities. Social distances are measured with tools developed in social psychology. I find preference reversals only with weak social distances, where subjects do not take into account social distances when they form a valuation. When social distances become stronger with the charities, subjects take social distances into account for both choice and valuation and preference reversals disappear. These results confirm that social preference reversals exist and that social distances are a relevant attribute.

Finally, in the last Chapter, I test the main assumption of the model in the context of the asymmetric dominance effect. I replicate the effect but find it to be smaller than previously thought. Especially, it disappears when targeting risky low-probability, high-payoff gambles. There is also evidence of a range effect, which verifies the assumption of the model presented in the first Chapter.

Acknowledgements

My name, as per the style guidelines of the University of Nottingham, may be the big one on the title page, but I would not have been able to complete this thesis alone.

First and foremost, I wish to thank my supervisors, Chris Starmer and Daniel Seidmann, who have guided me and supported me during those long four years. I would not be the aspiring academic I am today without them. I also wish to thank my Masters thesis supervisor, Astrid Hopfensitz from the Toulouse School of Economics, who nurtured my conversion to behavioural and experimental economics. And I am indebted to Nick Netzer from the University of Zurich: My thesis took a different turn after meeting him and our discussions formed the basis of the chapters you will find in the next pages.

I will never forget the support I received from members of the School of Economics: Other Ph.D. students who provided much-needed laughs, audience participants at our internal conferences; and the support staff, especially Sue Andrews, Sue Berry, Hilary Clayton, Sue MacCormick, Sarah Nolan, and Suzanne Robey. Support staff is not often acknowledged in the research process but we would not even be able to start a project without them.

I am grateful for the financial support of the Economic and Social Research Council and of the School of Economics, which granted me peace of mind regarding my bank account. They have also allowed me to travel to attend conferences and meet academics much smarter than I am. Support from the Centre for Decision Research and Experimental Economics, which funded the experiments reported in this thesis, is also acknowledged.

Finally, I want to express my gratitude for my girlfriend, Chloé Fons, who has always been at my side, even in the darkest times.

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Introduction

The study of risky choice and of intertemporal choice have followed similar trajectories: Both emerged in the late 17th century, with Pascal's (1670) wager and de Witt's (1671) valuation of life annuities; and were developed during the next two centuries, thanks to Bernoulli's (1738) solution to the St. Petersburg Paradox, Halley's (1761) formula of present value, and Rae's (1834) and Böhm von Bawerk's (1890) investigations of the psychological foundations of temporal discounting. Both were cemented in economics in the first half of the 20th century, with expected utility (von Neumann and Morgenstern, 1944) and discounted utility (Fisher, 1930; Samuelson, 1937). These theories have had their highs – Savage's (1954) subjective-expected utility, Koopmans's (1960) axiomatisation of the discounted utility model – and lows – Allais's (1953) criticism of the postulates and axioms of expected utility theory, Thaler's (1981) demonstration of dynamic inconsistency – which generated new theories, such as prospect theory (Kahneman and Tversky, 1979) and hyperbolic discounting (Laibson, 1997)¹.

Both strands have also kept their object of analysis firmly separate. Risky choice focuses on probabilities and intertemporal choice on temporal delays, expected utility with the independence axiom and discounted utility with the stationarity axiom. It is not too far fetched, however, to imagine that probabilities and delays may trigger similar psychological mechanisms. After all, they serve the same purpose in their respective models: probabilities

¹See the reviews by Frederick et al. (2002); Loewenstein (1992); Schoemaker (1982); Starmer (2000). On the early origins of intertemporal choice, see also Rubinstein (2003); and Kupperts (2014) for an essay on the life and contribution of de Witt.

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and delays indicate by how much the outcome should be discounted. The outcome attribute itself, for example money, is already assumed to have the same effect across domains, with researchers often using the utility measured in risky choice as a control for the estimation of the discount factor².

I am not the first one to make this observation. It can be traced back to Rotter (1954)³ who speculated that people with poor self-control choose smaller, sooner rewards over larger, later rewards because they believe that delayed rewards may never be delivered; for them, delay equates subjective probability. Since then, researchers have explored the relation between risky choice and intertemporal choice, and their experiments all follow the same structure⁴: Subjects face the choice between the small reward sooner or the large reward later. For one group, researchers manipulate the delays of the rewards; for the other group, they add risk to the rewards. Manipulation of both delays and risk is sometimes done for a third group. The general finding is that manipulating time or manipulating risk has the same effect on choice, the researchers concluding that the two domains are driven by the same psychological mechanisms.

In the course of this thesis, I will explore some of those background psychological mechanisms at play across domains. I start with a model assuming that people place more weight on an attribute when it differs more in the set of options offered to them. This mechanism organises the literature on choice inconsistencies in risky choice and intertemporal choice without assuming that a domain is a derivative of the other. It can thus be applied to other domains, and I do so by considering social distances and predict new choice inconsistencies when choice involves social distances. I then seek out and find preference reversals between choice and valuation in

²See for example Andersen et al. (2008), but this approach has been called into question: see Andreoni and Sprenger (2012) and Abdellaoui et al. (2013).

³I was unable to access this reference myself and had to rely on second-hand accounts found in the papers cited in the next footnote.

⁴In psychology, see for example Mischel and Grusec (1967), Rachlin et al. (1987), Benzion et al. (1989), Rachlin et al. (1991), Rachlin and Siegel (1994), and Keren and Roelofsma (1995). Closer to economics, see Weber and Chapman (2005a), Chapman and Weber (2006) and Baucells and Heukamp (2010).

the social domain. Since preference reversals also exist in the risk and time domain, this finding further reinforces that, despite the different objects of interest – probabilities, delays, social distances –, the domains are driven, at least partially, by the same mechanisms. Finally, I look for the psychological mechanism underlying the model in the context of choice between gambles and revisit the asymmetric dominance effect in doing so.

But before we go there, you might wonder *why* we should approach similarly probabilities, delays and social distances in the first place. Try the following: Picture your favourite cake; think of yourself eating it and imagine the pleasure this would bring. Then, imagine eating it only if a coin lands on heads. Chances are that the mental pleasure you feel is not as strong as before, and will diminish as the probability of eating the cake decreases. A similar phenomenon happens if you imagine eating the cake tomorrow, in two weeks, in a month or in a year. Now, think of someone else eating the cake. You would feel a similar mental pleasure if the cake-eater is a close one, for example your partner or your child; but you would hardly feel any if she is a complete stranger. In all cases, the increase in psychological distance between you and the cake dims the mental pleasure, which we might call the anticipatory utility. I am not claiming that probabilities, delays and social distances are exactly the same; simply, that they may trigger similar psychological effects.

Construal level theory (Liberman and Trope, 1998) provides less-casual evidence. Its premise is that things must be mentally constructed if they cannot be directly and immediately experienced. There are different levels of mental constructions, referred to as ‘construals’: low-level construals are concrete and pertain to the ‘how’ of an action, while high-level construals are abstract and pertain to the ‘why’. The same low-level construal can be translated into different high-level ones. For example, ‘waving a hand’ could become ‘being friendly’ but also ‘being threatening’ depending on the context (Liberman et al., 2007, p. 353). In the translation, some features, such as the hand, are lost; but meaning is also gained: the friendliness or the threat were absent in the original low-level construal. The central proposition of

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construal level theory is that more psychologically distant things should be constructed on a higher level. Psychological distance results from things belonging to the future or the past (temporal distance), to other places (physical distance), to other people (social distance), or from hypotheticality (probabilities). These four distances will cause a similar move to high-level construals and so will trigger similar psychological mechanisms.

This theory has spawned an enormous literature⁵. Of most interest to us are studies on the interplay between the psychological distances. For example, Pronin et al. (2008) found that the decisions we take for our future selves and for other persons are often the same, and Bartels and Rips (2010) further observed that people discount the future less when they are more connected to their future self. Yi et al. (2011) also verified that temporal delays affect the perception of social distances. Finally, the results of Wakslak (2012) indicate that probabilities are mentally associated with other psychological distances. These and the many other studies in the construal-level-theory literature point out that people do not perceive probabilities, delays and social distances as separate entities ruled by their own axioms and operating independently; but instead that these are all special cases of a common, ‘psychological distance’ attribute.

I will set the scene in the first Chapter, with a model providing a common explanation to the documented anomalies in risky choice and intertemporal choice. The model makes novel predictions, two of which are tested in the subsequent Chapters. Chapter 2 addresses the prediction that well-known anomalies in risky choice and intertemporal choice extend to choice across social distances, by documenting preference reversals between choice and valuation in the social domain. Then, Chapter 3 tests for the presence of pure range effects in risky choice. This prediction is also verified, which lends support to the psychological mechanism at the core of the model.

⁵See Trope and Liberman (2003), Liberman et al. (2007) and Trope and Liberman (2010) for extensive reviews.

Explaining preference reversals across domains with a focusing model

Similar phenomena have been documented in risky choice and in intertemporal choice. I use a simple model to organise the literature and provide a common explanation to these phenomena. The model, building upon Köszegi and Szeidl (2013), is based on a psychological mechanism: increasing the range of values of a particular attribute in the consideration set increases the weight placed on this attribute. I also show how the model can explain preferences reversals between choice and valuation, as well as different forms of context-induced reversals such as the asymmetric dominance effect. Finally, I extend the model to choice involving social distances and predict new anomalies.¹

Keywords: preference reversals, focusing, risky choice, intertemporal choice, social distance

JEL codes: D03, D81, D90, D63

1.1 Introduction

Risky choice and intertemporal choice are traditionally studied independently, with either expected utility or discounted utility. Most alternative models, such as prospect theory and hyperbolic discounting, have continued to keep them independent. Prelec and Loewenstein (1991), however, pointed out the relation between the standard models and their anomalies. This observation has prompted a literature which established that probabilities and delays

¹I thank Daniel Seidmann and Chris Starmer for their comments on earlier versions.

affect utility in similar ways (Anderhub et al., 2001; Benzion et al., 1989; Keren and Roelofsma, 1995; Weber and Chapman, 2005a). In response, models linking risky choice and intertemporal choice have been devised. Some assume that the future is inherently risky, thus treating intertemporal choice as a derivative of risky choice (Epper et al., 2011; Halevy, 2008; Quiggin and Horowitz, 1995). Others view probabilities as measures of how many times on average a gamble should be played to see a success, thus interpreting risky choice as a derivative of intertemporal choice (Rachlin et al., 1986, 1991; Rachlin and Siegel, 1994).

Instead, I keep the two separate but show how the same mechanism creates similar patterns in risky choice and intertemporal choice. The mechanism is simple, and supported by psychological evidence: when people face options characterised by an amount of money and a probability or a delay, they place more importance on the attribute in which the options differ more. I adapt Köszegi and Szeidl (2013) and set up a model based on this mechanism. The model organises the experimental literature and provides a common explanation to a number of phenomena, depending on which attribute the mechanism is applied to: common ratio effects when applied to probabilities, common difference effects for delays, and magnitude effects when the mechanism targets money amounts. The model also captures preference reversals between choice and valuation. Since the mechanism is domain-independent, it can be applied to other attributes than probabilities and delays. I do so by extending the model to social distances and translate the well-known effects to this new domain, thus predicting ‘common social distance effects’ akin to common delay effects, magnitude effects in the social domain, and preference reversals between choice and valuation of allocations.

The psychological literature on range effects supports the mechanism through which the model operates. For instance, Goldstein (1990) asked subjects to rate 6 hypothetical apartments characterised by monthly rent and time to walk to campus. In one condition, the spread of rents was ‘wide’, ranging from \$250 to \$500. In the other, it was ‘narrow’, from \$300 to \$400.

The range of time to walk to campus was held constant across conditions. Goldstein found that rent played a greater role in subjects' ratings when the range of rents was wide. A similar result appears in the weight-change literature (Fischer, 1995; Mellers and Cooke, 1994; von Nitzsch and Weber, 1993; Wedell, 1998; Wedell and Pettibone, 1996): when fitting a model in which attributes are weighted, researchers observe that the weights change depending on the spread of the attributes. Complementary evidence is provided by similarity effects: similarity along one attribute intensifies the differences along the other attribute (Mellers and Biagini, 1994; Mellers et al., 1992a,b).

I start by embedding the psychological mechanism into a model (Section 1.2). Instead of providing an explanation as to the cause of this mechanism, I take it as given and follow the reduced-form approach of Kőszegi and Szeidl (2013). The decision-maker considers options (x, d) , in which x is an amount of money and d measures the psychological distance between the option and the decision-maker. Instead of an undistorted, context-independent utility function $U(x, d) = f(d)u(x)$, the decision-maker's utility depends on the structure of the set of options considered, referred to as the consideration set $\mathcal{C}$. First, the decision-maker forms the *attention spans* by looking at the range of attributes and computing the difference between maximum and minimum values for each attribute. For example, the attention span of the distance attribute is $\Delta_d = \max_{d \in \mathcal{C}_d} f(d) - \min_{d \in \mathcal{C}_d} f(d)$. Second, each attribute is weighted by its associated attention span, resulting in the modified utility $\tilde{U}(x, d; \mathcal{C}) = f(d)^{\Delta_d} u(x)^{\Delta_x}$. This two-step process captures the essence of the example described earlier: more spread out attribute values increase the weight placed on this attribute. To put it differently, the decision-maker focuses more his or her attention on attributes that differ more, hence $\tilde{U}$ bearing the name of *focus-weighted* utility. I conclude this section by assessing which transformations preserve $\tilde{U}$ and isolating the situations in which U and $\tilde{U}$ make the same predictions.

I first apply the model to the choice between two options (Section 1.3). If the options are gambles, the psychological distance is a probability p and the

undistorted utility function has the expected utility form $U(x, p) = pu(x)$. If they are delayed outcomes, the distance is a delay t and U has the discounted utility form $U(x, t) = \delta^t u(x)$. Focus-weighted utility $\tilde{U}$ retains these forms but weights each attribute by its corresponding attention span. Its main property is that, when the options become closer in terms of distances d , the attention span Δ_d decreases and choice is driven more by the money attribute; and when the options become closer in terms of money amounts x , Δ_x decreases and choice is driven more by the distance attribute. When distances are interpreted as probabilities, this property predicts the common ratio effect. This effect refers to the situation in which people prefer £3000 for sure to £4000 with $p = 0.8$ (and £0 otherwise), but prefer £4000 with $p = 0.2$ over £3000 with $p = 0.25$ (Kahneman and Tversky, 1979; Starmer and Sugden, 1989). The ratio of winning probabilities remains the same ($1/0.8 = 0.25/0.2$), so the effect challenges expected utility, but the difference between probabilities diminishes ($1 - 0.8 > 0.25 - 0.2$), which in the model translates to the probability attribute receiving less weight. As a consequence, the probability attribute matters less in choice, which is now driven by the money attribute, and so £4000 with $p = 0.2$ is chosen. Then, when distances are interpreted as temporal delays d , the property predicts the common delay effect: people tend to prefer one apple today to two apples tomorrow, but they also prefer two apples in a year and a day to one apple in just a year (Thaler, 1981). The property also predicts magnitude effects in the risk and time domains in a similar fashion when it is applied to the money attribute. Finally, I study preference reversals between choice and valuation. Valuation is modelled as a sequence of choice between the option to be valued and all possible valuations. The model explains these preference reversals and provides a formalisation of the scale compatibility hypothesis (Tversky et al., 1988).

I then study the impact of adding a third option (Section 1.4). Adding an option whose attributes are within the existing attribute ranges has no effect; but if the third option changes the attention spans, then reversals can occur. These are the pure range effects discussed at length in the psychological

literature. I also consider decoy effects (Huber et al., 1982) due to their similarity with range effects, and show how the model can be modified to accommodate them. Finally, I show how the model predicts intransitive choice.

My approach so far has been to take the undistorted utility U as a given, which is expected utility or discounted utility, and to generate the focus-weighted utility $\tilde{U}$ by weighting each attribute with its attention span. So, other domains can be studied as long as the corresponding U is provided. I do so in the last section by considering a new measure of psychological distance: social distances s . First, one needs to know what U would be with social distances. Evidence, reviewed in Section 1.5, shows that choice over time and choice across social distances are the most similar. Choice over time is based on the stationarity axiom, which says that, if you are indifferent between an apple today and two apples tomorrow, then you should be indifferent between an apple in a month and two apples in a month and day. In other words, only the delay difference matters. I extend it to choice across social distances with an ‘empathy axiom’: if you are indifferent between getting £10 or your best friend getting £15, then you should be indifferent between a stranger getting £10 and *their* best friend getting £15: only the differences in social distance matter. This axiom implies that preferences defined over social distances can be represented by $U(x, s) = \sigma^s u(x)$ with x an amount of money, s a social distance, and σ a social discount factor. All effects seen in the risk and time domain can then be directly translated to this new domain: The model predicts hyperbolic social discounting, which has already been observed. It also predicts magnitude effects in the social domain, according to which people would become more concerned about the amount of the donation as the recipients become more socially distant. Finally, I extend preference reversals between choice and valuation to allocations.

Relation to the literature Models incorporating attention and focusing have a long tradition in economics, starting with Loomes and Sugden (1982)². I directly build on the model by Kőszegi and Szeidl (2013) so a discussion of how their model relates to mine is warranted. They consider consumption bundles (c_1, c_2) in which attribute c_i generates utility $u_i(c_i)$ in situation i , so c_1 and c_2 can be thought as independent goods. For example, (c_1, c_2) is an intertemporal consumption plan with $u_1(c_1)$ the realised utility at $t = 1$ and $u_2(c_2)$ the realised utility at $t = 2$; or an allocation providing $u_1(c_1)$ to person 1 and $u_2(c_2)$ to person 2. Focus-weighted utility is given by $\tilde{U}(c_1, c_2; \mathcal{C}) = g(\Delta_1)u_1(c_1) + g(\Delta_2)u_2(c_2)$. Probabilities, delays and social distances do not appear in this model; only utility realised at these distances do.

As a consequence, we provide different explanations of the phenomena we both study, such as the common delay effect. Since Kőszegi and Szeidl do not consider delays per se, their model cannot capture simple examples such as the ‘one apple today vs two apples tomorrow’ example. However, they shed a new light on this phenomenon by using the distribution of costs and benefits over time. My explanation follows the classical examples and the experimental literature more closely. Furthermore, their focus is mainly on choice over time, with some applications to allocations. They do not provide an extension to choice under risk, and they recognise that it is not clear how one would do so. By contrast, my model can be easily applied to any of these domains. Bordalo et al. (2012) are faced with a similar problem. Their model is specialised to choice under risk and exploits the state-space structure to provide explanations of anomalous behaviour, in a fashion reminiscent of Loomes and Sugden (1982), and cannot easily be transposed to the time domain.

Finally, Prelec and Loewenstein (1991) also provide a model that predicts similar patterns in risky choice and intertemporal choice. They do not study social distances but their model could easily be extended to them. However,

²In addition to the papers mentioned in the main text, see Gabaix (2014); Rubinstein (1988); Schwartzstein (2014); Sims (2003).

our approaches differ: Their is to modify the shape of the functions f and u to explain the different anomalies based on a psychophysics argument. Mine is still to change the implicit shape of the functions, but based on the distribution of attribute values in the consideration set.

1.2 A theory of focusing – revisited

1.2.1 Setup

The decision-maker faces options $(x, d) \in \mathcal{C} \subset X \times D$. x is an amount of money, and d is a psychological distance, for example a probability p or a distance t . To capture the different distances, I say that attribute d has a positive polarity, denoted $d_{(+)}$, when more of this attribute is preferred to less; and a negative polarity, $d_{(-)}$, when less is preferred to more (Prelec and Loewenstein, 1991). Under the standard assumptions, the decision-maker's *undistorted utility* is given by the utility function $U(x, d) = f_d(d)u(x)$ with $u(0) = 0$, u increasing, $f_d(d_{(+)})$ increasing and $f_d(d_{(-)})$ decreasing with $f_d(d) > 0 \forall d$, such that $\forall (x, d), (x', d') \in X \times D$, $(x, d) \succsim (x', d')$ if and only if $U(x, d) \geq U(x', d')$ (Fishburn and Rubinstein, 1982, and see Appendix A.1 for a complete axiomatisation of U).

However, instead of maximising U , the decision-maker maximises the *focus-weighted utility* (Kőszegi and Szeidl, 2013)

$$\tilde{U}(x, d; \mathcal{C}) = f_d(d)^{g(\Delta_d)} u(x)^{g(\Delta_x)}$$

in which $g(\Delta_d)$ is the focus-weight on the psychological distance attribute d and $g(\Delta_x)$ is the focus-weight on the money attribute x . The preferences represented by $\tilde{U}$ will be denoted by $\succsim_{\mathcal{C}}$.

The focus-weights are determined as follows:

Assumption 1. The *attention spans* Δ_d and Δ_x are the ranges of attributes

present in $\mathcal{C}$:

$$\Delta_d = \max_{d \in \mathcal{C}_d} f_d(d) - \min_{d \in \mathcal{C}_d} f(d),$$

$$\Delta_x = \max_{x \in \mathcal{C}_x} u(x) - \min_{x \in \mathcal{C}_x} u(x),$$

and the *focus weights* $g(\Delta_d)$ and $g(\Delta_x)$ are increasing in their arguments.

The set $\mathcal{C}$ can be different from the choice set Γ . Since the model is defined in terms of options in $\mathcal{C}$, only options in $\mathcal{C}$ matter and are considered by the decision-maker, so I shall refer to $\mathcal{C}$ as the ‘consideration set’. In principle, $\mathcal{C}$ and Γ can be related in several ways, but if $\mathcal{C} \subset \Gamma$ every single choice would be rationalisable. For example, if $\Gamma = \{a, b\}$, the choice of a could be explained by $\mathcal{C} = \{a\}$. So, I will assume $\Gamma \subseteq \mathcal{C}$.

Because it will not impact any of the results, I will assume that the function g is linear, which makes attention spans and focus weights interchangeable:

Assumption 2. $g(\Delta_d) = \Delta_d$ and $g(\Delta_x) = \Delta_x$.

To simplify the notation, I will also ignore the subscript on f_d , unless needed.

1.2.2 Properties

Before moving to the main results, I will explore some properties of the focus-weighted utility $\tilde{U}$ to illustrate how it differs from the undistorted utility U . First, note that the functions f and u can be rescaled without changing the ordering revealed by U , as described in the next Remark:

Remark. f' on D and u' on X also represent $\succsim$ if and only if there are $k, k_1, k_2 > 0$ such that $f' = k_1 f^k$ and $u' = k_2 u^k$.

Proof. Fishburn and Rubinstein (1982), Theorem 3, (iii). □

This result changes in the case of $\tilde{U}$, and only one specific rescaling leaves preferences unchanged.

Property 1. f' and u' also represent $\succsim_{\mathcal{C}}$ if and only if there exists $k > 0$ such that $f' = kf$ and $u' = ku$.

Proof. Let $\bar{f}' = \max_{d \in \mathcal{C}_d} f'(d)$, $\underline{f}' = \min_{d \in \mathcal{C}_d} f'(d)$, $\bar{f} = \max_{d \in \mathcal{C}_d} f(d)$ and $\underline{f} = \min_{d \in \mathcal{C}_d} f(d)$, and similarly with $\bar{u}'$, $\underline{u}'$, $\bar{u}$ and $\underline{u}$. We have:

$$\begin{aligned} f'(d_1)^{\bar{f}' - \underline{f}'} u'(x_1)^{\bar{u}' - \underline{u}'} &\geq f'(d_2)^{\bar{f}' - \underline{f}'} u'(x_2)^{\bar{u}' - \underline{u}'} \\ \Leftrightarrow (kf(d_1))^{k\bar{f} - k\underline{f}} (ku(x_1))^{k\bar{u} - k\underline{u}} &\geq (kf(d_2))^{k\bar{f} - k\underline{f}} (ku(x_2))^{k\bar{u} - k\underline{u}} \\ \Leftrightarrow f(d_1)^{\bar{f} - \underline{f}} u(x_1)^{\bar{u} - \underline{u}} &\geq f(d_2)^{\bar{f} - \underline{f}} u(x_2)^{\bar{u} - \underline{u}} \end{aligned}$$

□

So, f and u can be rescaled, but for $\tilde{U}$ to represent the same preferences and in contrast to U , they have to be rescaled by the same factor.

Similarly, if the options in $\mathcal{C}$ change in such a way that the attention spans are rescaled by the *same* factor, then the preferences would not change.

Property 2. Denote by (Δ_d, Δ_x) and (Δ'_d, Δ'_x) the attention spans in $\mathcal{C}$ and $\mathcal{C}'$. If $\Delta'_d = k\Delta_d$ and $\Delta'_x = k\Delta_x$ then $(x_1, d_1) \succsim_{\mathcal{C}} (x_2, d_2) \Leftrightarrow (x_1, d_1) \succsim_{\mathcal{C}'} (x_2, d_2)$.

Proof. $(x_1, d_1) \succsim_{\mathcal{C}'} (x_2, d_2) \Leftrightarrow f(d_1)^{\Delta'_d} u(x_1)^{\Delta'_x} \geq f(d_2)^{\Delta'_d} u(x_2)^{\Delta'_x} \Leftrightarrow f(d_1)^{k\Delta_d} u(x_1)^{k\Delta_x} \geq f(d_2)^{k\Delta_d} u(x_2)^{k\Delta_x} \Leftrightarrow f(d_1)^{\Delta_d} u(x_1)^{\Delta_x} \geq f(d_2)^{\Delta_d} u(x_2)^{\Delta_x} \Leftrightarrow (x_1, d_1) \succsim_{\mathcal{C}} (x_2, d_2)$. □

Finally, the predictions based on the undistorted utility U and on the focus-weighted utility $\tilde{U}$ sometimes coincide, so I will focus on cases in which the predictions differ. For example, when the attention spans Δ_d and Δ_x are equal, U and $\tilde{U}$ represent the same preferences.

Property 3. If $\Delta_d = \Delta_x$, then $(x_1, d_1) \succsim_{\mathcal{C}} (x_2, d_2) \Leftrightarrow (x_1, d_1) \succsim (x_2, d_2)$.

Proof. $\Delta_d = \Delta_x = \Delta$ and $(x_1, d_1) \succsim_{\mathcal{C}} (x_2, d_2) \Leftrightarrow \tilde{U}(x_1, d_1) \geq \tilde{U}(x_2, d_2) \Leftrightarrow f(d_1)^{\Delta} u(x_1)^{\Delta} \geq f(d_2)^{\Delta} u(x_2)^{\Delta} \Leftrightarrow f(d_1)u(x_1) \geq f(d_2)u(x_2) \Leftrightarrow U(x_1, d_1) \geq U(x_2, d_2) \Leftrightarrow (x_1, d_1) \succsim (x_2, d_2)$. □

Also, if an option is dominant in both attributes, standard utility U and attention-weighted utility $\tilde{U}$ generate the same predictions. It is formalised in the next Property:

Property 4. *If $u(x_1) > u(x_2)$ and $f(d_1) > f(d_2)$ then $(x_1, d_1) \succ (x_2, d_2) \Leftrightarrow (x_1, d_1) \succ_C (x_2, d_2)$.*

Proof. If $u(x_1) > u(x_2)$ and $f(d_1) > f(d_2)$, $f(d_1)u(x_1) > f(d_2)u(x_2) \Leftrightarrow U(\omega_1) > U(\omega_2)$. Since $\Delta_x, \Delta_d > 0$, $f(d_1)^{\Delta_d} > f(d_2)^{\Delta_d}$ and $u(x_1)^{\Delta_x} > u(x_2)^{\Delta_x}$ so $f(d_1)^{\Delta_d}u(x_1)^{\Delta_x} > f(d_2)^{\Delta_d}u(x_2)^{\Delta_x} \Leftrightarrow \tilde{U}(\omega_1) > \tilde{U}(\omega_2)$. $\square$

Thus, I will assume that one option is distance-dominant and the other is money-dominant:

Assumption 3. $\omega_1 = (x_1, d_1)$ and $\omega_2 = (x_2, d_2)$ such that $f(d_1) > f(d_2)$ and $u(x_2) > u(x_1)$.

1.3 Choice between two options: $\mathcal{C} = \{\omega_1, \omega_2\}$

In this Section, I will focus on the choice between two options and show how the model explains a range of choice anomalies documented in the literature.

So far, the model has been stated in general terms, only referring to d as a psychological distance. To apply the model to specific domains, more assumptions are needed. To study choice involving probabilities, the independence axiom will be added:

Axiom 1 (Independence). If $(x, p) \sim (x', p')$ and $\alpha \in]0, 1[$, then $(x, \alpha p) \sim (x', \alpha p')$.

Then $f_p(p) = p$ and U is expected utility. The focus-weighted utility is

$$\tilde{U}(x, p; \mathcal{C}) = p^{\Delta_p} u(x)^{\Delta_x}.$$

When choice involves delays, the stationarity axiom will be added instead:

Axiom 2 (Stationarity). If $(x, t) \sim (x', t + \tau)$ and $\tau > 0$, then $(x, t') \sim (x', t' + \tau)$.

The axiom implies $f_t(t) = \delta^t$, so U is discounted utility and the focus-weighted utility is

$$\tilde{U}(x, t; \mathcal{C}) = \delta^{t \cdot \Delta_t} u(x)^{\Delta_x}.$$

1.3.1 Common ratio, common delay, and magnitude effects

In the standard models captured by U , only ratios of attribute matter. As long as ratio are preserved, preferences do not change:

$$(x_1, d_1) \sim (x_2, d_2) \Leftrightarrow U(x_1, d_1) = U(x_2, d_2) \Leftrightarrow \frac{f(d_1)}{f(d_2)} = \frac{u(x_2)}{u(x_1)},$$

In contrast, because of the presence of attention spans, attribute differences also matter with $\tilde{U}$. This effect is captured in the following Proposition. Recall Assumption 3, and since $\mathcal{C} = \{\omega_1, \omega_2\}$,

$$\Delta_d = f(d_1) - f(d_2),$$

$$\Delta_x = u(x_2) - u(x_1).$$

Proposition 1. (i) If $(x_1, d_1) \sim_{\mathcal{C}} (x_2, d_2)$ and $\frac{f(d_1)}{f(d_2)} = \frac{f(d'_1)}{f(d'_2)}$, then $(x_1, d'_1) \succ_{\mathcal{C}'} (x_2, d'_2)$ if and only if $\Delta'_d = f(d'_1) - f(d'_2) > \Delta_d = f(d_1) - f(d_2)$.

(ii) If $(x_1, d_1) \sim_{\mathcal{C}} (x_2, d_2)$ and $\frac{u(x_2)}{u(x_1)} = \frac{u(x'_2)}{u(x'_1)}$, then $(x'_2, d_2) \succ_{\mathcal{C}'} (x'_1, d_1)$ if and only if $\Delta'_x = u(x'_2) - u(x'_1) > \Delta_x = u(x_2) - u(x_1)$.

Proof. (i) $(x_1, d_1) \sim_{\mathcal{C}} (x_2, d_2) \Leftrightarrow \left(\frac{f(d_1)}{f(d_2)}\right)^{\Delta_d} = \left(\frac{u(x_2)}{u(x_1)}\right)^{\Delta_x}$. Take d'_1, d'_2 such that $\frac{f(d'_1)}{f(d'_2)} = \frac{f(d_1)}{f(d_2)}$. $(x_1, d'_1) \succ_{\mathcal{C}'} (x_2, d'_2) \Leftrightarrow \left(\frac{f(d'_1)}{f(d'_2)}\right)^{\Delta'_d} > \left(\frac{u(x_2)}{u(x_1)}\right)^{\Delta_x}$ occur if and only if $\Delta'_d > \Delta_d$.

Table 1.1: Consequence of the change of an attention span in each domain.

	Risk	Time	Social
Δ_d	Common ratio	Common delay	Common social distance
Δ_x	Reverse peanuts effect	Magnitude effect	Magnitude effect

(ii) Similar.

□

Imagine that the attention span of money Δ_x increases ((ii) of the above Proposition). This increase leads to a range effect: the decision-maker puts more weight on $u(x)$, and as a consequence, the money-dominant option ω_2 is chosen. One could interpret this effect as money receiving more attention. On the other hand, imagine that Δ_x decreases. This decrease leads to a similarity effect: the decision-maker puts relatively more weight on $f(d)$, which makes the distance-dominant option ω_1 the chosen option.

Depending on which attention span increases or decreases, this simple property accommodates a range of experimental phenomena and explain new ones, as presented in Table 1.1. For instance, when the distance attribute changes while keeping the ratio constant, the model predicts the well-known common ratio effects and common delay effects.

Example (Common ratio). Consider the choice between the gambles $\omega_1^p = (x_1, p; 0, 1 - p)$ and $\omega_2^p = (x_2, \alpha p; 0, 1 - \alpha p)$ with $x_2 > x_1$ and $\alpha \in]0, 1[$. According to expected utility, if $\omega_1^p \sim \omega_2^p$, then $\omega_1^{p'} \sim \omega_2^{p'} \forall p' \neq p$, which is a direct consequence of the independence axiom. Numerous studies, however, have observed that the risky option ω_2^p is eventually chosen as p diminishes and as the two gambles become riskier (Kahneman and Tversky, 1979; Starmer and Sugden, 1989)³. In the context of the present model, this effect is a similarity effect. With $\mathcal{C} = \{\omega_1^p, \omega_2^p\}$, we have $\Delta_p = p - \alpha \cdot p =$

³See also Allais (1953); Battalio et al. (1990); Carlin (1992), and finally Starmer (2000) for more references.

1.3 Choice between two options

$p(1 - \alpha)$, which is monotonic in p . Thus, lowering p means Δ_p decreases and Proposition 1 applies: ω_2^p gets chosen.

Example (Common delay). Consider the choice between the delayed payoffs $\omega_1^t = (x_1, t)$ and $\omega_2^t = (x_2, t + \tau)$ with $x_2 > x_1$ and $\tau > 0$. According to discounted utility, if $\omega_1^t \sim \omega_2^t$, then $\omega_1^{t'} \sim \omega_2^{t'} \forall t' \neq t$, a direct consequence of the stationarity axiom. Similarly to what happens with the common ratio effect, studies have found that the more distant option ω_2^t is chosen as t increases and both options are pushed farther into the future (Benzion et al., 1989; Thaler, 1981)⁴. For us, it is again a similarity effect. With $\mathcal{C} = \{\omega_1^t, \omega_2^t\}$, we have $\Delta_t = \delta^t - \delta^{t+\tau} = \delta^t(1 - \delta^\tau)$, which decreases as t increases since $\delta \in [0, 1]$, so Proposition 1 applies: ω_2^t is chosen.

These examples illustrate the impact of decreasing the attention span of the distance dimension. Note that the model also applies in the opposite direction: if one starts from a situation in which $\omega_2 \succ_{\mathcal{C}} \omega_1$ and Δ_d increases, then ω_1 would eventually be chosen.

Moving to the money attribute, the model accommodates magnitude effects of different sorts, most obviously in the time domain.

Example (Magnitude effect in the time domain). Again, consider delayed payoffs $\omega_1^t = (x_1, t_1)$ and $\omega_2^t = (x_2, t_2)$ with $t_2 > t_1$ and $\frac{u(x_2)}{u(x_1)} = \beta > 1$. If $\omega_1^t \sim \omega_2^t \Leftrightarrow \frac{u(x_2)}{u(x_1)} = \beta = \delta^{t_1-t_2}$, then $\omega_1^t \sim \omega_2^t \forall \frac{u(x_2')}{u(x_1')} = \beta = \delta^{t_1-t_2}$: as long as the ratio of utilities is preserved, people should not change their decision. It is usually observed, however, that people tend to choose ω_2^t as the magnitude of the payoffs increases (Kirby, 1997; Thaler, 1981)⁵. In the

⁴See Frederick et al. (2002) for additional references.

⁵There are too many studies reporting this effect to cite them all; refer again to Frederick et al. (2002) for a complete list. As they point out, these studies generally assume that u is linear and use $\omega_1^t = (x, t_1)$, $\omega_2^t = (\beta x, t_2)$ with $t_2 > t_1$ and $\beta > 1$. With this assumption, the magnitude effect is a magnitude effect of money, not of utility. Prelec and Loewenstein (1991) have argued that the magnitude effect should go away once the curvature of the utility function is taken into account. However, after controlling for utility curvature, Chapman (1996) and Andersen et al. (2013) have found a magnitude effect, albeit a much smaller one. By using on the ratio of utilities, not of money amounts, the example recognises the importance of utility curvature.

model, since $\Delta_x = u(x_2) - u(x_1)$, Δ_x increases when the payoffs increase. Thus, Proposition 1 applies and ω_2^t gets chosen.

Example (Reverse peanuts effect). Take again some gambles $\omega_1^p = (x_1, p_1; 0, 1 - p_1)$ and $\omega_2^p = (x_2, p_2; 0, 1 - p_2)$ with $p_1 > p_2$ and $\frac{u(x_2)}{u(x_1)} = \beta > 1$. As in the previous example, if $\omega_1^p \sim \omega_2^p \Leftrightarrow \frac{u(x_2)}{u(x_1)} = \beta = \frac{p_1}{p_2}$, then $\omega_1^p \sim \omega_2^p \forall \frac{u(x'_2)}{u(x'_1)} = \beta = \frac{p_1}{p_2}$. On the contrary, the present model predicts that increasing the magnitude of utilities increases the range Δ_x , which implies $\omega_2^p \succ_C \omega_1^p$: people choose the high risk and high payoff gamble. Unfortunately for the model, the exact opposite is most commonly accepted: increasing the magnitude makes people more risk averse, and decreasing it makes them more risk taking; an effect dubbed the ‘peanuts effect’ (Markowitz, 1952; Weber and Chapman, 2005b). A ‘reverse peanuts effect’ occurs in the model because magnitude effects are assumed to operate similarly in the time domain (see the previous example) and in the risk domain; while the classical peanuts effect require magnitude effects to operate differently: making the decision-maker more patient in the time domain but more risk averse in the risk domain. Other researchers trying to provide a general model encompassing choice under risk and choice over time have faced the same challenge (Prelec and Loewenstein, 1991). Note, however, that the reverse peanuts effect is also sometimes observed (Chapman and Weber, 2006; Jones and Oaksford, 2011), and while Weber and Chapman (2005b) have found the peanuts effect when $\frac{p_1}{p_2} = 2$ or 4, they have also found a reverse peanuts effect when $\frac{p_1}{p_2} = 1.25$. All in all, at this stage it is not clear which one of the peanuts effect or the reverse peanuts effect is the correct effect to be embedded in a model, and it may well be that the two effects can manifest depending on other characteristics of the consideration set.

Next, I compare two decision-makers with different f or u .

Proposition 2. *Take two decision-makers $i = \{1, 2\}$. Decision-maker i ’s preferences $\succsim_C^i$ are represented by $\tilde{U}_i(x, d) = f_i(d)^{\Delta_d^i} u_i(x)^{\Delta_x^i}$. Assume $\omega_1 \sim_C^1 \omega_2$.*

1.3 Choice between two options

(i) If $f_2 = f_1$ and $\exists \mu$ strictly concave, such that $u_2 = \mu \circ u_1$, and satisfying $\mu'(x)x \leq \mu(x)$ and $\mu'(u_1(x_1)) \leq u_1'(x_1)$, then $\omega_1 \succ_C^2 \omega_2$.

(ii) If $u_2 = u_1$ and $\exists \phi$ strictly concave, such that $f_2 = \phi \circ f_1$, and satisfying $\phi'(x)x \leq \phi(x)$ and $\phi'(f_1(d_2)) \leq f_1'(d_2)$, then $\omega_2 \succ_C^2 \omega_1$.

Proof. (i) Denote decision-maker i 's attention span by (Δ_x^i, Δ_d^i) . Since $f_1 = f_2 = f$, $\Delta_d^1 = \Delta_d^2 = \Delta_d$. $\mu'(x)x < \mu(x)$ ensures that $\frac{u_2(x_2)}{u_2(x_1)} \leq \frac{u_1(x_2)}{u_1(x_1)}$, while $\mu'(u_1(x_1)) \leq u_1'(x_1)$ ensures that $\Delta_x^1 > \Delta_x^2$. Putting everything together, $\omega_1 \sim_C^1 \omega_2 \Leftrightarrow \left(\frac{f(d_1)}{f(d_2)}\right)^{\Delta_d} = \left(\frac{u_1(x_2)}{u_1(x_1)}\right)^{\Delta_x^1}$ and $\left(\frac{u_1(x_2)}{u_1(x_1)}\right)^{\Delta_x^1} > \left(\frac{u_2(x_2)}{u_2(x_1)}\right)^{\Delta_x^2}$ so $\left(\frac{f(d_1)}{f(d_2)}\right)^{\Delta_d} > \left(\frac{u_2(x_2)}{u_2(x_1)}\right)^{\Delta_x^2} \Leftrightarrow \omega_1 \succ_C^2 \omega_2$.
(ii) Similar. □

Loosely speaking, decision-makers with more concave u tend to choose the distance-dominant option while those with more concave f tend to choose the money-dominant option. The added assumptions make sure that, for example, u_2 lies below and is flatter than u_1 between x_1 and x_2 .

1.3.2 Reversals between choice and valuation

Pairwise choice is one way to get at people's preferences. I will now study another one: valuation. According to standard economic theory, people's preferences should not change between different elicitation methods. Researchers have instead repeatedly found that revealed preferences vary between choice and valuation, a phenomenon known as 'preference reversal'. I will start by applying the model to the literature in which valuations and preference reversals most commonly appear.

Classical preference reversals in the risk domain

In the classical preference reversal experiment (Lichtenstein and Slovic, 1971, 1973; Lindman, 1971; Plott and Grether, 1979), subjects face two gambles: one gamble (the 'P-bet') gives a small amount of money with a large probability; the other (the '\$-bet') gives a large amount of money

with a small probability. These are the gambles we have already seen: $\omega_1^p = (x_1, p_1)$ and $\omega_2^p = (x_2, p_2)$ with $p_1 > p_2$ and $u(x_2) > u(x_1)$.

In the course of the experiment, a subject completes two tasks. In the first task, ‘*Choice*’, the subject makes a pairwise choice between the two gambles. Choice works as in the previous subsection: the consideration set is $\mathcal{C}^c = \{\omega_1^p, \omega_2^p\}$ and the attention spans are $\Delta_x = u(x_2) - u(x_1)$ and $\Delta_p = p_1 - p_2$. Choice directly reveals the preference $\succ_{\mathcal{C}^c}$.

In the second task, ‘*Monetary Valuation*’, the subject reports an amount of money x_i^{MV} that makes her indifferent between an option $\omega_i^p = (x_i, p_i)$ and x_i^{MV} with certainty. So, x_i^{MV} is the certainty equivalent of ω_i^p . I model the process of forming a certainty equivalent as a sequence of choices between $\omega_i = (x_i, p_i)$ and the implicit options $\{(x_i^{\text{MV}}, 1), x_i^{\text{MV}} \in [0, x_i]\}$. The smallest valuation considered by a subject is 0; the largest is the winning amount of the gamble to be valued. This last assumption comes from dominance: Any $x_i^{\text{MV}} > x_i$ with certainty would be preferred to (x_i, p_i) , and so cannot be the valuation making the subject indifferent. Subjects might think about about these valuations temporarily, but I effectively assume that they do not consider them long enough to affect the consideration set. Such assumption about dominance detection is common in the literature (in same context, see for example Butler and Loomes, 2007). The consideration set resulting from these many implicit options is $\mathcal{C}_i^{\text{MV}} = \{\omega_i^p, \{(x_i^{\text{MV}}, 1)\}\}$, which generates the attention spans $(\Delta_{x,i}^{\text{MV}}, \Delta_{p,i}^{\text{MV}})$. The parameters and attention spans are summarised in Figure 1.1. Monetary valuation directly reveals the preferences $\omega_1^p \sim_{\mathcal{C}_1^{\text{MV}}} (x_1^{\text{MV}}, 1)$ and $\omega_2^p \sim_{\mathcal{C}_2^{\text{MV}}} (x_2^{\text{MV}}, 1)$. If $x_1^{\text{MV}} > x_2^{\text{MV}}$, ω_1^p is said to be *indirectly* revealed preferred to ω_2^p .

The literature on preference reversals has established that reversals in which subjects choose the P-bet but value more the \$-bet are more frequent than reversals in which they choose the \$-bet but value more the P-bet (Seidl, 2002; Starmer, 2000), thus being named ‘standard’ and ‘counter’ preference reversals. These definitions are formalised as follows:

Definition. There is a *standard preference reversal* between Choice and

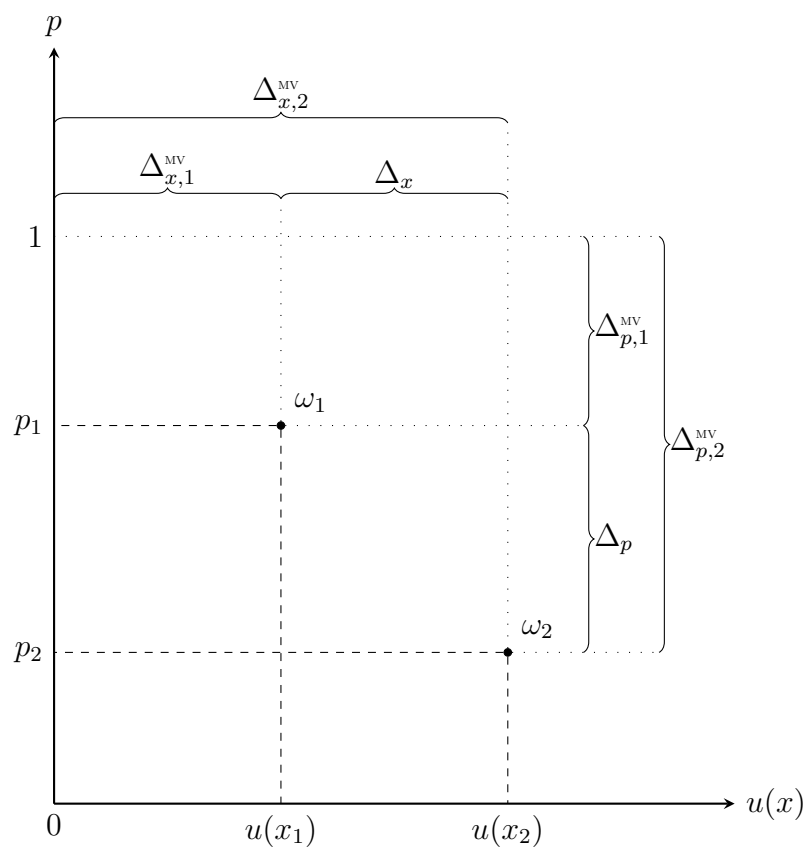


Figure 1.1: Attention spans in Choice and Monetary Valuation.

1 Explaining preference reversals across domains with a focusing model

Monetary Valuation if ω_1^p is directly revealed in Choice, $\omega_1^p \succ_{\mathcal{C}^c} \omega_2^p$, and ω_2^p is indirectly revealed preferred in Monetary Valuation, $x_2^{\text{MV}} > x_1^{\text{MV}}$. There is a *counter preference reversal* between Choice and Monetary Valuation if ω_2^p is directly revealed in Choice, $\omega_2^p \succ_{\mathcal{C}^c} \omega_1^p$, and ω_1^p is indirectly revealed preferred in Monetary Valuation, $x_1^{\text{MV}} > x_2^{\text{MV}}$.

With all the elements in place, I can now characterise standard and counter preference reversals.

Proposition 3. *There is a standard preference reversal between Choice and Monetary Valuation if*

$$\left(\frac{p_1}{p_2}\right)^{\frac{\Delta_p}{\Delta_x}} > \frac{u(x_2)}{u(x_1)} > \frac{p_1 \Delta_{p,1}^{\text{MV}} / \Delta_{x,1}^{\text{MV}}}{p_2 \Delta_{p,2}^{\text{MV}} / \Delta_{x,2}^{\text{MV}}}$$

and a counter preference reversal when the inequalities are reversed.

Proof. $\omega_1^p \succ_{\mathcal{C}^c} \omega_2^p \Leftrightarrow p_1 \Delta_p u(x_1)^{\Delta_x} > p_2 \Delta_p u(x_2)^{\Delta_x} \Leftrightarrow \left(\frac{p_1}{p_2}\right)^{\Delta_p / \Delta_x} > \frac{u(x_2)}{u(x_1)}$, which gives the first inequality.

Then, from the Monetary Valuation of ω_1^p , we have

$$\begin{aligned} \omega_1^p \sim_{\mathcal{C}^{\text{MV}}} (x_1^{\text{MV}}, 1) &\Leftrightarrow p_1 \Delta_{p,1}^{\text{MV}} u(x_1)^{\Delta_{x,1}^{\text{MV}}} = u(x_1^{\text{MV}})^{\Delta_{x,1}^{\text{MV}}} \\ &\Leftrightarrow u(x_1^{\text{MV}}) = u(x_1) p_1^{\Delta_{p,1}^{\text{MV}} / \Delta_{x,1}^{\text{MV}}}, \end{aligned}$$

and similarly from the Monetary Valuation of ω_2^p ,

$$\omega_2^p \sim_{\mathcal{C}^{\text{MV}}} (x_2^{\text{MV}}, 1) \Leftrightarrow u(x_2^{\text{MV}}) = u(x_2) p_2^{\Delta_{p,2}^{\text{MV}} / \Delta_{x,2}^{\text{MV}}}.$$

Then, preference for ω_2^p is implicitly revealed in Monetary Valuation if

$$\begin{aligned} x_2^{\text{MV}} > x_1^{\text{MV}} &\Leftrightarrow u(x_2) p_2^{\Delta_{p,2}^{\text{MV}} / \Delta_{x,2}^{\text{MV}}} > u(x_1) p_1^{\Delta_{p,1}^{\text{MV}} / \Delta_{x,1}^{\text{MV}}} \\ &\Leftrightarrow \frac{u(x_2)}{u(x_1)} > \frac{p_1^{\Delta_{p,1}^{\text{MV}} / \Delta_{x,1}^{\text{MV}}}}{p_2^{\Delta_{p,2}^{\text{MV}} / \Delta_{x,2}^{\text{MV}}}}, \end{aligned}$$

which gives the second inequality. □

1.3 Choice between two options

The first inequality in Proposition 3 refers to Choice and means that ω_1^p is chosen. The right portion ensures that ω_2^p is given a higher valuation in Monetary Valuation, and can be seen as a formalisation of the scale compatibility hypothesis (Tversky et al., 1988, 1990). Scale compatibility says that reporting a monetary valuation leads a subject to overweight the monetary attribute of the gambles, leading her into revealing a preference for the \$-bet in monetary valuation. In the inequality, probabilities have to be under-weighted in Monetary Valuation compared to Choice, or similarly, money amounts have to be over-weighted, for a preference reversal to happen.

To focus on pure scale compatibility effects, I assume that subjects are initially indifferent between the two gambles, so Monetary Valuation tips them into revealing a preference for one gamble or the other. This assumption results in the following, simpler characterisation of preference reversals:

Proposition 4. *Let $\omega_1^p \sim_{\mathcal{C}^c} \omega_2^p$. If $(1 - p_2)u(x_1) - (1 - p_1)u(x_2) > 0$ and*

(i) $p_1^{\frac{u(x_2)}{u(x_1)}} > p_2$, there is a standard preference reversal,

(ii) $p_1^{\frac{u(x_2)}{u(x_1)}} < p_2$, there is a counter preference reversal.

If $(1 - p_2)u(x_1) - (1 - p_1)u(x_2) < 0$, the inequalities are reversed.

Proof. With $\omega_1^p \sim_{\mathcal{C}^c} \omega_2^p$, the condition for a standard preference reversal in Proposition 3 becomes

$$\left(\frac{p_1}{p_2}\right)^{\frac{\Delta_p}{\Delta_x}} > \frac{p_1^{\Delta_{p,1}^{\text{MV}}/\Delta_{x,1}^{\text{MV}}}}{p_2^{\Delta_{p,2}^{\text{MV}}/\Delta_{x,2}^{\text{MV}}}} \Leftrightarrow p_1^{\frac{\Delta_p}{\Delta_x} - \frac{\Delta_{p,1}^{\text{MV}}}{\Delta_{x,1}^{\text{MV}}}} > p_2^{\frac{\Delta_p}{\Delta_x} - \frac{\Delta_{p,2}^{\text{MV}}}{\Delta_{x,2}^{\text{MV}}}}. \quad (1.1)$$

Further, the attention spans in Monetary Valuation are

$$\begin{aligned} \Delta_{x,1}^{\text{MV}} &= u(x_1), \\ \Delta_{p,1}^{\text{MV}} &= 1 - p_1, \\ \Delta_{x,2}^{\text{MV}} &= u(x_2), \\ \Delta_{p,2}^{\text{MV}} &= 1 - p_2. \end{aligned}$$

With these, we have

$$\begin{aligned}\frac{\Delta_p}{\Delta_x} - \frac{\Delta_{p,1}^{\text{MV}}}{\Delta_{x,1}^{\text{MV}}} &= \frac{p_1 - p_2}{u(x_2) - u(x_1)} - \frac{1 - p_1}{u(x_1)} \\ &= \frac{(1 - p_2)u(x_1) - (1 - p_1)u(x_2)}{u(x_1)(u(x_2) - u(x_1))}, \\ \frac{\Delta_p}{\Delta_x} - \frac{\Delta_{p,2}^{\text{MV}}}{\Delta_{x,2}^{\text{MV}}} &= \frac{p_1 - p_2}{u(x_2) - u(x_1)} - \frac{1 - p_2}{u(x_2)} \\ &= \frac{(1 - p_2)u(x_1) - (1 - p_1)u(x_2)}{u(x_2)(u(x_2) - u(x_1))}.\end{aligned}$$

Plugging these in (1.1) leads to

$$p_1^{\frac{(1-p_2)u(x_1)-(1-p_1)u(x_2)}{u(x_1)(u(x_2)-u(x_1))}} > p_2^{\frac{(1-p_2)u(x_1)-(1-p_1)u(x_2)}{u(x_2)(u(x_2)-u(x_1))}}.$$

Since $u(x_2) - u(x_1) > 0$, both sides can be raised to the power $u(x_2) - u(x_1)$ without changing the inequality.

We then have to consider two cases. If $(1 - p_2)u(x_1) - (1 - p_1)u(x_2) > 0$, we can raise both sides to the power $1/((1 - p_2)u(x_1) - (1 - p_1)u(x_2))$ without changing the inequality, which leads to

$$p_1^{1/u(x_1)} > p_2^{1/u(x_2)},$$

with the inequality reversed for a counter preference reversals, which gives us (i) and (ii)

If $(1 - p_2)u(x_1) - (1 - p_1)u(x_2) < 0$, then raising to the power $1/((1 - p_2)u(x_1) - (1 - p_1)u(x_2))$ will change the inequality, and so the inequalities in (i) and (ii) have to be reversed. $\square$

The next example shows how the conditions work in practice.

Example. Tversky et al. (1990) used 18 different parameter sets. The parameter set generating the highest proportion of preference reversals (60%) was $\omega_1^p = (\$4, 0.97)$ and $\omega_2^p = (\$16, 0.31)$. Assuming u is linear, we have

1.3 Choice between two options

$(1 - p_2)u(x_1) - (1 - p_1)u(x_2) = (1 - 0.31)4 - (1 - 0.97)16 = 2.28 > 0$, so the conditions in Proposition 4 apply. Since $p_1^{u(x_2)/u(x_1)} = 0.97^{16/4} = 0.88 > 0.31$, the model predicts that subjects who were initially indifferent between ω_1^p and ω_2^p would report a higher valuation for ω_2^p , which works in favour of preference reversals.

On the other hand, the parameter set generating the lowest proportion of preference reversals (29%) was $\omega_1^p = (\$12, 0.92)$ and $\omega_2^p = (\$175, 0.06)$. $(1 - 0.06)12 - (1 - 0.92)175 = -2.75$, so the inequalities in Proposition 4 are reversed. We have $0.92^{175/12} = 0.3 > 0.06$, so a subject initially indifferent between the two gambles would report a higher valuation for ω_1^p , which works against preference reversals.

General case

The previous application focused on the risk domain; however, the model allows one to study preference reversals on more general terms, and a domain-free description of Monetary Valuation would be as follows. The experimenter asks a subject to report an amount of money x_i^{MV} that makes her indifferent between an option $\omega_i = (x_i, d_i)$ and $(x_i^{\text{MV}}, \bar{d})$. x_i^{MV} is chosen by the subject: $x_i^{\text{MV}} \in [x_{i,\min}^{\text{MV}}, x_{i,\max}^{\text{MV}}]$. $\bar{d}$ is fixed by the experimenter so that $(x_i^{\text{MV}}, \bar{d})$ is closer to the subject than the options to be valued: $f(\bar{d}) > f(d_i) \forall i$. The attention spans in valuation are then

$$\begin{aligned}\Delta_{x,i}^{\text{MV}} &= u(x_{i,\max}^{\text{MV}}) - u(x_{i,\min}^{\text{MV}}), \\ \Delta_{d,i}^{\text{MV}} &= f(\bar{d}) - f(d_i).\end{aligned}$$

In the case Proposition 4, I have made the following assumptions: $x_{i,\min}^{\text{MV}} = 0$, $x_{i,\max}^{\text{MV}} = u(x_i)$ and $f(\bar{d}) = 1$. Preference reversals are easier to obtain in the general case by choosing appropriately $x_{i,\min}^{\text{MV}}$, $x_{i,\max}^{\text{MV}}$ and $f(\bar{d})$.

By using delays instead of probabilities and following the same steps leading to Proposition 4, the model could capture preference reversals between choice and valuation in the time domain, which have been observed

as well (Tversky et al., 1990).

Note that Monetary Valuation is only one of the two types of valuation possible. In the other one, *Distance Valuation*, the subject reports a distance d_i^{dv} that makes her indifferent between an option $\omega_i = (x_i, d_i)$ and $(\bar{x}, d^{\text{dv}})$. Now, d_i^{dv} is chosen by the subject: $d_i^{\text{dv}} \in [d_{i,\min}^{\text{dv}}, d_{i,\max}^{\text{dv}}]$. $\bar{x}$ is fixed by the experimenter so that it provides less money to the subject: $x_i > \bar{x} \forall i$.

1.4 Choice between three options:

$$\mathcal{C}' = \{\omega_1, \omega_2, \omega_3\}$$

1.4.1 Independence of irrelevant alternatives

I now introduce a third option $\omega_3 = (x_3, d_3)$, and look at its influence on the preference ordering between ω_1 and ω_2 .

If the added option does not change the attention spans, then the preference ordering has no reason to change. This intuition is formalised in the next Proposition.

Proposition 5. *Let $\mathcal{C} = \{\omega_1, \omega_2\}$ and $\mathcal{C}' = \{\omega_1, \omega_2, \omega_3\}$. If $u(x_3) \in [u(x_1), u(x_2)]$ and $f(d_3) \in [f(d_2), f(d_1)]$, then $\omega_1 \sim_{\mathcal{C}} \omega_2 \Leftrightarrow \omega_1 \sim_{\mathcal{C}'} \omega_2$.*

Proof. Denote by (Δ'_x, Δ'_d) the attention spans in $\mathcal{C}'$. Since $u(x_3) \in [u(x_1), u(x_2)]$ and $f(d_3) \in [f(d_2), f(d_1)]$, $\Delta'_x = \Delta_x$ and $\Delta'_d = \Delta_d$, and $\omega_1 \sim_{\mathcal{C}} \omega_2 \Leftrightarrow \omega_1 \sim_{\mathcal{C}'} \omega_2$ follows. $\square$

On the other hand, if the attention spans change after the introduction of ω_3 , then the preference ordering can change and preferences will depend on irrelevant alternatives added to the consideration set.

Proposition 6. *Let $\mathcal{C} = \{\omega_1, \omega_2\}$ and $\mathcal{C}' = \{\omega_1, \omega_2, \omega_3\}$.*

- (i) *If $f(d_3) \in [f(d_2), f(d_1)]$, then $\exists u(x_3) \notin [u(x_1), u(x_2)]$ such that $\omega_1 \sim_{\mathcal{C}} \omega_2 \Rightarrow \omega_2 \succ_{\mathcal{C}'} \omega_1$.*

(ii) If $u(x_3) \in [u(x_1), u(x_2)]$, then $\exists f(d_3) \notin [f(d_2), f(d_1)]$ such that $\omega_1 \sim_{\mathcal{C}} \omega_2 \Rightarrow \omega_1 \succ_{\mathcal{C}'} \omega_2$.

Proof. (i) Since $f(d_3) \in [f(d_2), f(d_1)]$, $\Delta_d = \Delta'_d$. Imagine that $u(x_3) > u(x_2) \Leftrightarrow \Delta'_x = u(x_3) - u(x_1) > \Delta_x = u(x_2) - u(x_1)$. Then, $\left(\frac{u(x_2)}{u(x_1)}\right)^{\Delta'_x} > \left(\frac{u(x_2)}{u(x_1)}\right)^{\Delta_x} = \left(\frac{f(d_1)}{f(d_2)}\right)^{\Delta_d}$, the equality coming from $\omega_1 \sim_{\mathcal{C}} \omega_2$, which implies $\omega_2 \succ_{\mathcal{C}'} \omega_1$.

(ii) Similar. □

Propositions 5 and 6 allows one to test the crux of the model: increasing an attribute range makes people more likely to choose the option rich in this attribute. I will do so in Chapter 3 in the context of choice under risk.

1.4.2 Decoy effects

Proposition 6 implies that decisions based on focus-weighted utility violate independence of irrelevant alternatives. Violations of this property are at the centre of the asymmetric dominance effect, which refers to the situation where adding an asymmetrically-dominated decoy changes the original choice probabilities. For example, in Figure 1.2, the asymmetrically-dominated decoy is ω'_1 : it is dominated by ω_1 but not by ω_2 . Researchers have generally observed that adding ω'_1 *increases* the choice probability of ω_1 (Herne, 1999; Huber et al., 1982; Wedell, 1991). If one tries to explain the asymmetric dominance effect using an attribute-weighting model, like the present focusing model, one needs the money attribute to have *less* weight when the decoy is introduced for ω_1 to be chosen. Range effects, however, go in the opposite direction. Adding ω'_1 increases the range of the money attribute from Δ_x to Δ'_x ; as we saw in Proposition 6, this increase causes the money attribute to receive *more* weight, which favours ω_2 .

The discrepancy between range effects and the weight change required to explain the asymmetric dominance effect has been noted by Wedell (1998) and Pettibone and Wedell (1996; 2000). The evidence they present suggests that a value-shift model is more adequate to capture it. In this type of model,

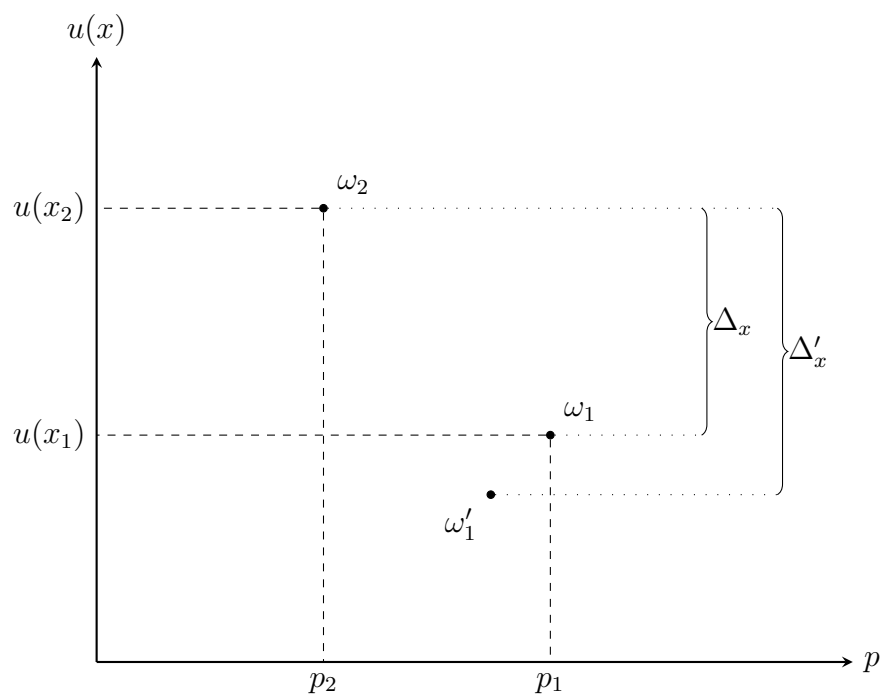


Figure 1.2: Range and decoy effects.

the whole value of an option is shifted when it dominates another option. This contrasts with attribute-weighting models in which the relative value of a single attribute changes depending on the context. To capture both effects, I propose the following modification of the focus-weighted utility

$$\tilde{U}(x, d; \mathcal{C}; \gamma) = \gamma \cdot f(d)^{g(\Delta_d)} u(x)^{g(\Delta_x)}$$

in which $\gamma = 1$ if (x, d) does not dominate any option, and $\gamma > 1$ if it dominates at least one option. Thus, the attention spans Δ_d and Δ_x still capture similarity and range effects, while γ captures the shift in value brought by asymmetric dominance. Both range and asymmetric dominance effects will be tested in the Chapter 3.

1.4.3 Transitivity

Finally, since the model violates independence of irrelevant alternatives, non-transitive behaviour is possible; I will now show how. The decision-maker faces three options and has to make three consecutive binary choices: ω_1 vs ω_2 , ω_2 vs ω_3 , and ω_3 vs ω_1 . Denote by $\mathcal{C}_{i,j}$ the consideration set when the binary choice is between ω_i and ω_j , and by $(\Delta_x^{i,j}, \Delta_d^{i,j})$ the associated attention spans.

If all options are always in the consideration sets, then the attention spans will not change from one binary choice to the next. Hence, there are no reasons for preferences to change and choice will be transitive. If, however, all consideration sets are not equal, then the attention spans might change between choices, which can give rise to non-transitivity. This intuition is formalised in the next Proposition.

Proposition 7 (Transitivity). *(i) If $\mathcal{C}_{i,j} = \mathcal{C} = \{\omega_1, \omega_2, \omega_3\} \forall (i, j)$, then transitivity is ensured.*

(ii) If $\exists \mathcal{C}_{i,j} \neq \{\omega_1, \omega_2, \omega_3\}$ and

$$1 > f(d_1)^{\Delta_d^{3,1}/\Delta_x^{3,1} - \Delta_d^{1,2}/\Delta_x^{1,2}} f(d_2)^{\Delta_d^{1,2}/\Delta_x^{1,2} - \Delta_d^{2,3}/\Delta_x^{2,3}} f(d_3)^{\Delta_d^{2,3}/\Delta_x^{2,3} - \Delta_d^{3,1}/\Delta_x^{3,1}},$$

1 Explaining preference reversals across domains with a focusing model

then transitivity is violated.

Proof. Without loss of generality, assume that

$$\omega_1 \succsim_{\mathcal{C}_{1,2}} \omega_2 \Leftrightarrow f(d_1)^{\Delta_d^{1,2}/\Delta_x^{1,2}} u(x_1) \geq f(d_2)^{\Delta_d^{1,2}/\Delta_x^{1,2}} u(x_2), \quad (1.2)$$

$$\omega_2 \succsim_{\mathcal{C}_{2,3}} \omega_3 \Leftrightarrow f(d_2)^{\Delta_d^{2,3}/\Delta_x^{2,3}} u(x_2) \geq f(d_3)^{\Delta_d^{2,3}/\Delta_x^{2,3}} u(x_3), \quad (1.3)$$

and transitivity is violated if

$$\omega_3 \succ_{\mathcal{C}_{3,1}} \omega_1 \Leftrightarrow f(d_3)^{\Delta_d^{3,1}/\Delta_x^{3,1}} u(x_3) > f(d_1)^{\Delta_d^{3,1}/\Delta_x^{3,1}} u(x_1). \quad (1.4)$$

If $\mathcal{C}_{1,2} = \mathcal{C}_{2,3} = \mathcal{C}_{3,1}$, then $\Delta_d^{1,2} = \Delta_d^{2,3} = \Delta_d^{3,1} = \Delta_d$ and $\Delta_x^{1,2} = \Delta_x^{2,3} = \Delta_x^{3,1} = \Delta_x$. With the attention spans equal, (1.2), (1.3) and (1.4) can not hold at the same time, so choice can not be non-transitive, which proves (i).

When (1.2), (1.3) and (1.4) hold,

$$\begin{aligned} u(x_1) &\geq u(x_2) \left(\frac{f(d_2)}{f(d_1)} \right)^{\Delta_d^{1,2}/\Delta_x^{1,2}} \\ &\quad \text{from (1.2),} \\ &\geq u(x_3) \left(\frac{f(d_3)}{f(d_2)} \right)^{\Delta_d^{2,3}/\Delta_x^{2,3}} \left(\frac{f(d_2)}{f(d_1)} \right)^{\Delta_d^{1,2}/\Delta_x^{1,2}} \\ &\quad \text{from (1.3),} \\ &> u(x_1) \left(\frac{f(d_1)}{f(d_3)} \right)^{\Delta_d^{3,1}/\Delta_x^{3,1}} \left(\frac{f(d_3)}{f(d_2)} \right)^{\Delta_d^{2,3}/\Delta_x^{2,3}} \left(\frac{f(d_2)}{f(d_1)} \right)^{\Delta_d^{1,2}/\Delta_x^{1,2}} \\ &\quad \text{from (1.4),} \end{aligned}$$

which boils down to

$$1 > f(d_1)^{\Delta_d^{3,1}/\Delta_x^{3,1} - \Delta_d^{1,2}/\Delta_x^{1,2}} f(d_2)^{\Delta_d^{1,2}/\Delta_x^{1,2} - \Delta_d^{2,3}/\Delta_x^{2,3}} f(d_3)^{\Delta_d^{2,3}/\Delta_x^{2,3} - \Delta_d^{3,1}/\Delta_x^{3,1}}.$$

This inequality is satisfied only if $\exists(i, j, k)$ such that $\frac{\Delta_d^{i,k}}{\Delta_x^{i,k}} \neq \frac{\Delta_d^{k,j}}{\Delta_x^{k,j}}$, which is only possible when two consideration sets are different, which proves (ii). $\square$

Note that choice is not transitive only from the point of view of the undistorted preferences $\succsim$. From the perspective of $\succsim_C$, the non-transitive behaviour is justified by changes in consideration set.

1.5 Choice across social distances

I have considered two psychological distances so far: probabilities p and delays t . Because the model has been stated in terms of a general psychological distance d and none of the results rely on the structure of a particular domain, it is possible to study other, less-common psychological distances. I will illustrate this feature by extending the model to the social domain and interpreting d as a social distance s . Thus, the options are now allocations (x, s) which provide an amount x to a person or a group socially distant from the decision-maker by s . But before going further, I must describe what U would look like in the social domain and provide an adequate replacement for Axioms 1 and 2.

There is ample evidence in different strands of literature that choice over time and choice across social distances are similar. Researchers, mostly in psychology, have observed that people discount others' payoffs as a function of the social distance, just as they do with the temporal distance; an observation referred to as 'social discounting' (Jones and Rachlin, 2006). Economists have also provided anecdotal evidence by showing that people become more pro-social when some form of 'social distance' decreases (Hoffman et al., 1996). Further, researchers have also observed that social discounting behaviour and temporal discounting behaviour are related at the individual level (Jones and Rachlin, 2009), which is predicted by a number of psychological theories such as construal level theory (Trope and Liberman, 2010) and Albert (1977)'s derivation of temporal-comparison theory from Festinger (1954)'s social comparison theory⁶.

⁶The voracious reader will refer to the following additional studies: On social discounting, see Bradstreet et al. (2012); Rachlin and Jones (2008a,b); Sharp et al. (2012). On the link between pro-sociality and social distance in economics, see Bohnet and Frey

So, I assume that choice across social distances is similar to choice over time and introduce the following axiom, mirroring the stationarity axiom:

Axiom 3 (Empathy). If $(x, s) \sim (x', s + \kappa)$ and $\kappa > 0$, then $(x, s') \sim (x', s' + \kappa)$.

The axiom implies $f_s(s) = \sigma^s$ with $\sigma \in [0, 1]$, σ being the ‘social discount factor’. The undistorted utility is then

$$U(x, s) = \sigma^s u(x). \quad (1.5)$$

To the best of my knowledge, Axiom 3 has not yet appeared in the literature, so it merits some discussion. In the time domain, the stationary axiom (Axiom 2 on page 14) states that if you are indifferent between an apple today and two apples tomorrow, then you should be indifferent between an apple in a month and two apples in a month and a day. So, you should give as much importance to your future self as you give to your present self. Axiom 3 imposes a similar restriction. Imagine that everyone has a friend distant by κ . If you are indifferent between you getting an apple and your friend receiving two apples, then you should be indifferent between anyone getting an apple and *their* friend receiving two apples. When making a choice, you should take their perspective—hence ‘empathy’.

Note that I have also implicitly assumed monotonicity of money in the social domain. It is a reasonable assumption when people deal with probabilities or temporal delays, but it is more contentious when they deal with social distances: it means that you should always prefer other people to receive more, no matter the social distance. Hence, behaviours such as spite or negative reciprocity are ruled out.

While the empathy axiom did not appear as such, the utility representation (1.5) has a long tradition in economics. It has been hinted at by Smith

(1999); Chen and Li (2009); Frey and Bohnet (1997); Hoffman et al. (1994); Ruffle and Sosis (2006). On the relation between social discounting and temporal discounting, see Curry et al. (2008); Fehr and Leibbrandt (2011); Ida and Ogawa (2012). Finally, see Bartels and Rips (2010); Liviatan et al. (2008); Pronin et al. (2008); Pronin and Ross (2006) for more studies on construal level theory.

(1759), and especially by Edgeworth (1881, Appendix IV, “On Mixed Modes of Utilitarianism.”) who wrote⁷:

between the frozen pole of egoism and the tropical expanse of utilitarianism [there is] ...the position of one for whom in a calm moment his neighbour’s utility compared with his own neither counts for nothing, nor ‘counts for one’, but counts for a fraction. We must modify the utilitarian integral by multiplying each pleasure, except the pleasures of the agent himself, by a fraction—a *factor doubtless diminishing with what may be called the social distance between the individual agent and those of whose pleasures he takes account.* [emphasis added]

I can now state the focus-weighted utility in the social domain

$$\tilde{U}(x, s; \mathcal{C}) = \sigma^{s \cdot \Delta_s} u(x)^{\Delta_x},$$

and thus all results that we have seen can be applied to the social domain. I will go over a few of those, starting with Proposition 1 to generate two new predictions. The first one relates to the social distance attribute:

Prediction 1 (Common social distance). Consider the choice between the allocations $\omega_1^s = (x_1, s)$ and $\omega_2^s = (x_2, s + \kappa)$ with $x_2 > x_1$ and $\kappa > 0$. ω_1^s provides a small amount of money to a socially-closer other, while ω_2^s provides a larger amount to a more distant other. The social distance between the two potential recipients, κ , is fixed. Constant social discounting (1.5) implies that if $\omega_1^s \sim \omega_2^s$, then $\omega_1^{s'} \sim \omega_2^{s'} \forall s' \neq s$, a consequence of the empathy axiom. However, with $\mathcal{C} = \{\omega_1^s, \omega_2^s\}$, the attention span for the social distance attribute is $\Delta_s = \sigma^s - \sigma^{s+\kappa} = \sigma^s(1 - \sigma^\kappa)$, which decreases when s increases. So, if both social distances increase, Proposition 1 applies and ω_2^s is chosen.

⁷See respectively Sally (2001) and Collard (1975) on how these classical authors had already introduced the idea of a social discount factor.

As the allocations concern more socially distant recipients, focus-weighted utility predicts that the decision-maker will eventually choose the money-rich allocation ω_2^s . Thus, social discounting is hyperbolic, akin to what happens in the time domain. Jones and Rachlin (2006; 2008b; 2009) have observed hyperbolic social discount functions, but they used only hypothetical social distances in non-incentivised experiments. The only study observing hyperbolic social discounting while using real social distances that I know is Goeree et al. (2010). In this field experiment, they elicited people's social network and were thus able to compute the distance s between any two people on the network. Then, they asked participants to play dictator games with different people on the network and found that dictators' giving decisions were inversely related to s . This inverse relation, $1/s$, is an hyperbolic discount function, similar to the one found by Jones and Rachlin.

Proposition 1 also applies to the money attribute, and extends magnitude effects to the social domain:

Prediction 2 (Magnitude effect in the social domain). Consider again the allocations $\omega_1^s = (x_1, s_1)$ and $\omega_2^s = (x_2, s_2)$ with $s_2 > s_1$ and $\frac{u(x_2)}{u(x_1)} = \beta > 1$. If $\omega_1^s \sim \omega_2^s \Leftrightarrow \frac{u(x_2)}{u(x_1)} = \beta = \delta^{s_1 - s_2}$, then $\omega_1^s \sim \omega_2^s \forall \frac{u(x'_2)}{u(x'_1)} = \beta$. In the focus-weighted-utility model, $\Delta_x = u(x_2) - u(x_1)$ which increases when $u(x_1)$ and $u(x_2)$ increase even when keeping the ratio constant. So, Proposition 1 applies and ω_2^s gets chosen.

This last prediction implies that people would care less about the social distance attribute and choose to maximise the amount of money donated as the magnitude of payoffs increases. For example, people would favour a close relative over a stranger for small amounts of money, but instead choose to give the largest amount of money to the stranger if all amounts increase.

Finally, the preference reversal phenomenon, studied in Section 1.3.2, can also be extended to the social domain:

Prediction 3 (Preference reversals between choice and valuation in the social domain). To mirror P-bets, define P-allocations – ‘Proximate’-allocation –

which provide a small amount of money to an individual or a group socially close to the decision-maker. Similarly, to mirror \$-bets, define \$-allocations which provide a large amount of money to a socially-distant individual or group. With the notation I have used since the beginning, the P-allocation is $\omega_1^s = (x_1, s_1)$, the \$-allocation is $\omega_2^s = (x_2, s_2)$ and we have $x_2 > x_1$ and $s_2 > s_1$. In Choice, a subject chooses between the P-allocation and the \$-allocation. In Monetary Valuation, she reports the amount of money that makes her indifferent between this amount of money and an allocation. There is a preference reversal if the preference directly revealed in Choice and the preference indirectly revealed in Monetary Valuation do not match. Proposition 4 suggests that preference reversals in the social domain can happen for some (ω_1^s, ω_2^s)

In order to test this prediction, many questions need to be answered. First and foremost, one needs a way to measure social distances in order to be able to select recipients characterised by small and large social distances in order to construct the P- and \$-allocations. One also needs to actually implement and incentivise the allocations in a laboratory setting, which is not trivial. In the next Chapter, I will provide answers to these questions and study preference reversals in the social domain.

1.6 Conclusion

To explain the similarities between the risky choice and intertemporal choice, I have proposed a model based on a simple psychological mechanism: people put more weight on attributes which differ more in their consideration set. The model allows me to organise the experimental literature on intertemporal and risky choice, which may seem disparate otherwise. It also provides a characterisation of preference reversals between choice and valuation, and a simple way to capture context-dependent preferences such as in the asymmetric dominance effect. The model can easily be extended to other domains; I do so by extending it to choice across social distances and generate

new predictions.

The model repurposes and builds upon Kőszegi and Szeidl (2013)'s focusing model. It retains their reduced-form approach due to its simplicity, but it is also its main weakness. I do not provide an explanation as to why people would overweight an attribute in some situations, and as such the model cannot be seen as a general theory of choice. The model studies context-dependent choice, and it is itself very much dependent on the context in which it is applied. For example, the model breaks as soon as the utility of money is too far from the distance transformation.

As I have stressed, the model generates new predictions, some of which will be tested in the subsequent chapters. The next Chapter will investigate the preference reversals between choice and valuation in the social domain. The last Chapter will test the main mechanism through which the model operates and will also replicate the asymmetric dominance effect.

Preference reversals in the social domain

2

People prefer to give money to socially-close others. Using a lab-based social-distance experiment, I study the stability and consistency of such preferences and compare preferences elicited with different, but strategically equivalent, methods. I find that preferences are reversed between methods when money benefits individuals but not when it benefits charities and use tools from social psychology, the Inclusion of Other in the Self and the Inclusion of Ingroup in the Self, to show that social distance explains these differences.¹

Keywords: preference reversal, social distance, laboratory experiment, Inclusion of Other in the Self, Inclusion of Ingroup in the Self

JEL codes: C91, D03, D64

2.1 Introduction

People care about others², and they care less when the others are socially

¹I am grateful to Jingcheng Fu, Alessio Gaggero, Kian Howe Ong, Till Weber, and especially Ashira Perera, for helping me to conduct the sessions. I thank Robin Cubitt, Gianni De Fraja, Daniel Seidmann, Chris Starmer, and audience participants at the Warwick Economics PhD Conference 2014, the ESA European Meeting 2015 in Heidelberg, the 14th TIBER Symposium in Psychology and Economics in Tilburg, and the 10th Nordic Conference on Behavioural and Experimental Economics in Tampere, for their comments on earlier versions.

²This is assumed in the study of social interactions (Becker, 1974; Bernheim and Stark, 1988; Bruce and Waldman, 1990), intergenerational transfers (Barro, 1974), relations in the workplace (Rotemberg, 1994) or the provision of public goods (Andreoni, 1989, 1990). As an experimental result, see, for example, ultimatum games (Güth et al., 1982) and dictator games (Forsythe et al., 1994), and Engel (2011), Fehr and Schmidt

distant from them. In the social discounting literature³, psychologists observe that proximity matters: people prefer money given to socially-close others over money given to distant others. Economists also find that the others matter less when they are more anonymous (Hoffman et al., 1996), less identifiable (Frey and Bohnet, 1997), part of the out-group (Chen and Li, 2009) or more distant in a network (Goeree et al., 2010).

According to rational choice theory, preferences are invariant to how they are expressed. So, people should prefer close others no matter how their preference is elicited. Numerous studies, however, have demonstrated that preferences vary systematically with the elicitation method⁴. This phenomenon is known as a *preference reversal*.

In this paper, I assess the stability and consistency of the preference for payments to socially-close or socially-distant recipients. I conduct a laboratory experiment to compare preferences revealed by different, but strategically equivalent, methods. I find preference reversals when the payments benefit individuals but not when the payments benefit charities.

Preference reversals are classically studied in the risk domain (Lichtenstein and Slovic, 1971; Lindman, 1971; Plott and Grether, 1979). I translate this design to the social domain (Section 2.2). The experiment uses two types of allocation: one provides a small amount of money to a socially-close recipient; the other provides a large amount of money to a socially-distant recipient. I elicit subjects' preferences between these two allocations in two ways: subjects make a pairwise choice; and they report a monetary valuation independently for each of the allocations. The *ordinal payoff scheme* (Tversky et al., 1990) makes these two elicitation methods strategically equivalent. If preferences are consistent and stable, the two methods should reveal the

(2006) and Camerer (2003) for reviews.

³For experimental evidence, see Bradstreet et al. (2012); Ida and Ogawa (2012); Jones and Rachlin (2006, 2009); Rachlin and Jones (2008b); Sharp et al. (2012). For theoretical work, see Sozou (2009); Takahashi (2007, 2010).

⁴Examples include when people deal with risky options (Slovic and Lichtenstein, 1968), delayed payments (Tversky et al., 1990), life-saving programs (Tversky et al., 1988), jobs with fair or unfair offers (Tversky and Griffin, 1991) or improvements in air quality (Irwin et al., 1993).

same preference.

The recipients of the two allocations are either individuals in different faculties or different charities. I introduce tools from social psychology (Section 3.3) to measure the social distances: the Inclusion of Other in the Self scale (Aron et al., 1992) measures the distance between a subject and an individual, and the Inclusion of Ingroup in the Self scale (Tropp and Wright, 2001) measures the distance between a subject and a charity.

I find that preferences are reversed between the two elicitation methods when the recipients are individuals but not when the recipients are charities (Section 2.4). Differences in how subjects report their monetary valuation explain this result. When subjects report a monetary valuation for an allocation benefiting an individual, they behave as if the social distance does not matter. This interpretation is supported by the Inclusion of Other in the Self and the Inclusion of Ingroup in the Self scores.

Literature review The literature on preference reversals is too large to be reviewed here in its entirety and the reader is directed to reviews by Tversky and Thaler (1990), Hsee et al. (1999), Starmer (2000) and Seidl (2002). Preference reversals emerged in psychology (Lichtenstein and Slovic, 1971, 1973; Lindman, 1971; Slovic and Lichtenstein, 1968) when researchers noticed that choice between lotteries and valuation of lotteries did not elicit the same preferences. Plott and Grether (1979) attempted to eliminate the preference reversal phenomenon in a series of carefully controlled experiments ‘to discredit the psychologists’ work as applied to economics’. Preference reversals did not vanish and subsequent studies tried to explain the phenomenon. Three explanations were proposed: failure of the independence axiom or the reduction axiom (Holt, 1986; Karni and Safra, 1987), failure of transitivity (Loomes and Sugden, 1983) and failure of procedure invariance (Tversky et al., 1988). Tversky et al. (1990) found that the failure of procedure invariance is the main source of preference reversals, a conclusion also reached by Cubitt et al. (2004). The prominence and the scale compatibility hypotheses (Tversky et al., 1988) have been proposed to

explain why procedure invariance fails. Butler and Loomes (2007) advanced another explanation based on imprecise preferences.

Bazerman et al. (1992) is the closest study to the present one. They also elicit the preference between allocations in different ways and find preference reversals. The allocations they use, however, are different. Their allocations benefit both the subject and a recipient while the allocations in the present study benefit only the recipient. Also, they use hypothetical payoffs, which allows them to study large amounts of money. In contrast, I use real, but small, amounts of money.

2.2 Preference reversals in the social domain

In a typical preference reversal experiment in the risk domain (Lichtenstein and Slovic, 1971), subjects face two tasks. In the ‘choice’ task, they choose between two gambles: one gamble (the ‘P-bet’) has a high probability of winning a small prize, the other (the ‘\$-bet’) has a low probability of winning a large prize. In the ‘valuation’ task, subjects report a monetary valuation independently for each gamble.

To translate P-bets and \$-bets to the social domain, I define two allocations: one allocation (the ‘P-allocation’) provides a small payment to a recipient socially close to the subject, the other (the ‘\$-allocation’) provides a large payment to a socially-distant recipient. Formally,

Definition 1. Let x_P and $x_\$$ be sums of money and s_P and $s_\$$ social distances such that $x_\$ > x_P$ and $s_P > s_\$$. The *P-allocation* is denoted by (x_P, s_P) and the *\$-allocation* by $(x_\$, s_\$)$.

In the choice task, subjects choose between the P-allocation and the \$-allocation. The preference revealed in this choice task is denoted by $\succ$. In the valuation task, subjects assign a monetary valuation independently to each allocation. $V(\cdot)$ denotes the value reported.

The *ordinal payoff scheme* (Tversky et al., 1990) makes the choice task and the valuation task strategically equivalent. Consider a subject facing n

2.2 Preference reversals in the social domain

pairs of P- and \$-allocations in the experiment. In each pair, the subject chooses between the P- and the \$-allocation (in the choice task) and reports a valuation for each allocation separately (in the valuation tasks). At the end of the experiment, a pair of allocations is selected with probability $1/n$. Then, the choice task or the valuation task is selected, each with probability $1/2$. If the choice task is selected, the subject's decision in the choice task for the selected pair of allocations will be implemented. If the valuation task is selected, the allocation which received the higher valuation in the pair of allocations selected will be implemented—so only the *ranking* of valuations matters.

Subjects are then categorised depending on their behaviour in the choice task and in the valuation task:

Definition 2. A subject has a *consistent preference for the P-allocation* if

$$(x_P, s_P) \succ (x_\$, s_\$) \text{ and } V(x_P, s_P) > V(x_\$, s_\$),$$

and a *consistent preference for the \$-allocation* if

$$(x_\$, s_\$) \succ (x_P, s_P) \text{ and } V(x_\$, s_\$) > V(x_P, s_P).$$

A subject exhibits a *standard preference reversal* if

$$(x_P, s_P) \succ (x_\$, s_\$) \text{ and } V(x_\$, s_\$) > V(x_P, s_P)$$

and a *counter preference reversal* if

$$(x_\$, s_\$) \succ (x_P, s_P) \text{ and } V(x_P, s_P) > V(x_\$, s_\$).$$

In the context of the ordinal payoff scheme, observing a single preference reversal is not incompatible with the existence of consistent and stable preferences. There is, however, no reason to expect a type of preference reversal to occur more frequently than the other (Cubitt et al., 2004). To see that, note that a subject committing a standard preference reversal or

a counter preference reversal effectively faces the same gamble under the ordinal payoff scheme: the P- and the \$-allocation both have a 50%-chance of being implemented. The preference reversal literature has established that standard preference reversals occur more often than counter preference reversals. If this conclusion can be extended,

Prediction. In the social domain, the proportion of standard preference reversals is statistically significantly different from the proportion of counter preference reversals.

I explore this prediction in the experiment.

2.3 Experimental design

2.3.1 Social distances in the laboratory

I study two types of recipients: individuals and charities. To construct the allocations, a close recipient in the P-allocation and a distant recipient in the \$-allocation are needed.

To find close and distant recipients, I use the Inclusion of Other in the Self (IOS) scale (Aron et al., 1992) and the Inclusion of Ingroup in the Self (IIS) scale (Tropp and Wright, 2001) (see Figure 2.1 for an example). In the IOS scale, respondents face seven pairs of overlapping circles and select the pair of circles which best describes their closeness to an individual. The IIS scale uses the same representation to measure the closeness to a group. The higher the score reported, the closer the target and the smaller the social distance. Aron et al. (1992) and Tropp and Wright (2001)⁵ show that the IOS and IIS scales measure social distances better than the scales used in the previous literature. They also show that these scales satisfy key desirable properties: alternate-form reliability, test-retest reliability, convergent validity with other measures of closeness, discriminant validity, minimal social desirability

⁵See also Aron et al. (2004a,b); Cialdini et al. (1997); Gächter et al. (2015); Schubert and Otten (2002); Wright et al. (2004).

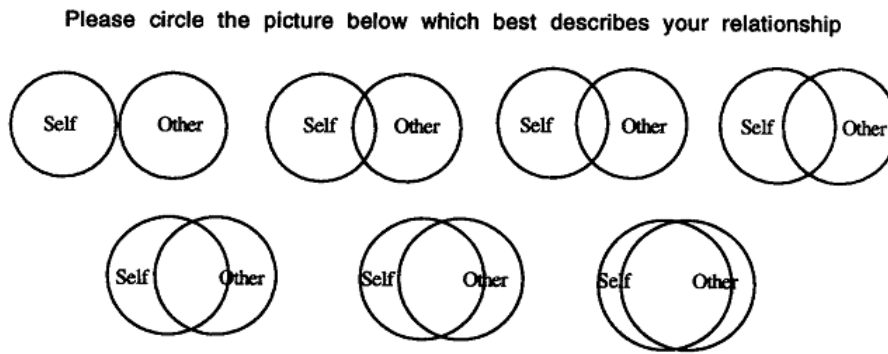


Figure 2.1: The Inclusion of Other in the Self scale (from Aron et al., 1992).
In the Inclusion of Ingroup in the Self scale, ‘Other’ is replaced by ‘Ingroup’.

effects and predictive validity for the IOS; construct validity, concurrent and discriminant validity and test-retest reliability for the IIS. Further, the measures capture objective and subjective dimensions of social distance: the IOS scale correlates with *behaving* close and *feeling* close (Aron et al., 1992), and people reporting higher IIS scores for a group feel that they share beliefs and values and have most in common with people in this group and are understood by them (Tropp and Wright, 2001).

Faculty setting

In the Faculty setting, the recipients of the allocations are of the individual type: subjects from a given faculty at the University of Nottingham are invited to participate in the experiment, and the allocations benefit students from other faculties.

To identify close and distant recipients, I conducted an online survey (see Appendix B.1 for details on the surveys) in which I invited students from all faculties at the University of Nottingham and administered the IOS scale with a student from another faculty as the target. Members of the Faculty of Arts reported the greatest difference in IOS scores between members of two other faculties: the Faculty of Social Sciences and the Faculty of

Engineering. Consequently, members of the Faculty of Arts were invited as subjects of the experiment, and members of the Faculty of Social Sciences were selected as recipients of the P-allocations and members of the Faculty of Engineering as recipients of the \$-allocations⁶.

Charity setting

In the Charity setting, the recipients are charities.

I conducted a second online survey in which participants completed the IIS scale with one of several charities as the target (the list of the charities used can also be found in Appendix B.1). I selected Cancer Research UK for the P-allocation and The Salvation Army for the \$-allocation because they received the highest and the lowest IIS scores in comparison to other charities.

2.3.2 Tasks

In the two settings, the payment of the P-allocation x_P is fixed at £5 and the payment of the \$-allocation x_S varies between £6 and £10, resulting in five pairs of allocations: (£5, £6), (£5, £7), (£5, £8), (£5, £9) and (£5, £10). All subjects face the five pairs and complete the following tasks in a decision booklet (*italicised words were used to describe the tasks to subjects*):

- In the *Allocation task*, subjects choose between the P- and the \$-allocation in a given pair of allocations. The presentation order is randomised for each subject and for each pair.

⁶One might be concerned that we do not capture social distances but merely stereotypes. It is not clear if stereotypes are part of (Viljoen, 1974) or different from (Sandefur and Lam, 1985) social distances. If stereotypes are one of the dimensions of social distance, our design stands clear of this concern. If they are not, stereotypes can be problematic if, for example, a subject is closer to the member of the Faculty of Engineering but decides to give to the member of the Faculty of Social Sciences because the subject thinks they are more needy. Staats (1978) shows that positive stereotypes reduce social distance and negative stereotypes increase it. As long as subjects have positive stereotypes about the recipients of the P-allocations and negative stereotypes about those of the \$-allocations, the effects of social distance and stereotypes are aligned.

- In the *Equivalence task*, subjects report a monetary valuation for an allocation.
- In the *Circle task*, subjects answer the IOS scale in the Faculty setting or the IIS scale in the Charity setting with respect to the recipient of an allocation.
- In the *Knowledge task*, specific to the Charity setting, subjects indicate how familiar they are with the charities to make sure that subjects knew Cancer Research UK and The Salvation Army.

Figure 2.2 shows examples of the tasks. In total, a subject completes 5 Allocation tasks (one for each pair), 6 Equivalence tasks (one for each allocation) and 2 Circle tasks (one for each recipient). In the Charity setting, there are also 2 Knowledge tasks (one for each charity). The order of the 13 or 15 tasks is randomised independently for each subject.

The instructions (which can all be found in Appendix B.2) extensively explain the ordinal payoff scheme. Subjects are guided through an example by the script reader and they have to answer questions to control for understanding. Also, allocations selected by the ordinal payoff scheme are actually implemented. For example, if the ordinal payoff scheme selects the allocation giving £7 to a member of the Faculty of Engineering, a member of the Faculty of Engineering is invited and receives £7. The invited members participate in the Charity setting. Subjects are provided the date, time and location of the experiments featuring the payment to members of the Faculties of Social Sciences and Engineering. They are actively encouraged to observe the sessions. In the Charity setting, Cancer Research UK and The Salvation Army are also paid according to the allocations selected and receipts of the donations are sent to the subjects.

2.3.3 Isolating the effect of social distances

Social distance and money should be the only explanation for subjects' behaviour. Thus, a number of factors need to be controlled for.

Option A: We give £5 to *the member of the Faculty of Social Sciences*

Option B: We give £10 to *the member of the Faculty of Engineering*

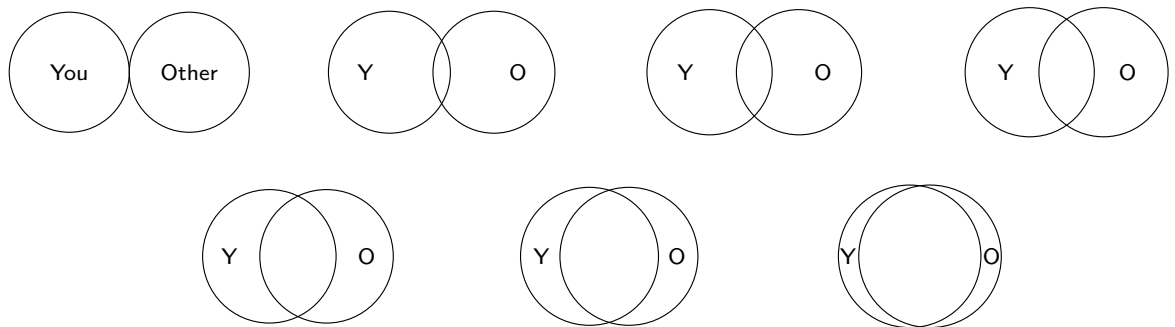
Choose **A** or **B**:

How much money *given to you* would be just as good as us giving £6 to *the Salvation Army*?

Please write the amount here:

We will refer to this amount as your equivalence valuation of giving £6 to the Salvation Army.

Please consider the member of the Faculty of Engineering. Select the pair of circles that best represents how you feel toward *the member of the Faculty of Engineering*:



Indicate your answer by drawing a line around the pair of circles you select.

Indicate how familiar you are with *The Salvation Army* by ticking one of the following options:

- ☐ I have never heard of it
- ☐ I have only heard the name
- ☐ I know the name but I have only a vague idea of what it does
- ☐ I know the name and I have a good idea of what it does

Figure 2.2: Examples of the tasks.

Subjects face allocations which never benefit themselves, so selfish motives are absent. It is different from, say, a dictator game, since subjects do not divide money between themselves and someone else.

Subjects are told that people or charities receiving or not receiving money as a consequence of their decisions will never know about the experiment. Receiving money is a complete surprise and appears to come from the experimenters. So, subjects have no reason to select an allocation because they believe it is what the recipient expects them to do.

Subjects can also be motivated to appear pro-social. These reputation concerns are controlled for by the use of a double-blind procedure (Hoffman et al., 1996). An identification number ensures the anonymity between the subjects and the experimenters. Further, the experimenters conducting the sessions never see the names of the subjects. People in charge of checking subjects' names stay outside the laboratory and are blind to the treatment. Effectively, subjects know that we can never infer who makes which choice.

2.4 Results

The experiment was conducted in the CeDEx laboratory at the University of Nottingham. Subjects were recruited with ORSEE (Greiner, 2004). 108 subjects participated in the experiment (56 in the Faculty setting and 52 in the Charity setting) over 6 sessions between mid-December 2014 and mid-January 2015. The average payment was £10.9 (min = £8, max = £21.5, standard deviation = £3.5) and the average session lasted 1 hour and 15 minutes.

2.4.1 Social preference reversals

I start by addressing the prediction:

Result 1. *In the Faculty setting, standard preference reversals and counter preference reversals occur in different proportions, and the difference is significant.*

2 Preference reversals in the social domain

In the Charity setting, standard and counter preference reversals occur in the same proportion, and the difference is not significant.

Table 2.2 reports the frequency of the patterns defined in Definition 2, in each setting, and for all pairs of P- and \$-allocations. I only consider cases in which the recipient of the P-allocation receives a higher IOS or IIS score than the recipient of the \$-allocation: this condition is part of the definition of P- and \$-allocations adopted (Appendix B.3 relaxes it). Figure 2.3 shows the proportion of the different patterns aggregated over all pairs of allocations.

We see that in the Faculty setting, standard preference reversals are common in all pairs while counter preference reversals do not occur often. Close to 50% of subjects' patterns are of the standard preference reversal type and there are few counter preference reversals (McNemar's $\chi^2(1) = 34.89$, $p = 0.00$). In the Charity setting, on the other hand, standard and counter preference reversals are few and occur in the same proportion (McNemar's $\chi^2(1) = 0.08$, $p = 0.78$), suggesting that they are the result of decision errors. Thus, only the Faculty setting replicates classical preference reversal experiments.

To investigate why there is such a difference between the settings, I estimate a conditional logit model to analyse choice and valuation data. I assume that the utility derived from a particular allocation is $U_i = \beta_x x_i + \beta_s s_i + \epsilon_i$ in which $i = \{\text{P-allocation, \$-allocation}\}$, x_i is the payment in the allocation, and s_i is the IOS or the IIS score reported by the subject for the recipient of the allocation. In the valuation task, a subject prefers an allocation if the valuation reported for this allocation is *strictly* greater than the valuation reported for the other allocation. Since we are using a logit model, we need to look at the ratio β_x/β_s to compare tasks. Note that the conditional logit model assumes that choice is independent of irrelevant alternatives and that all subjects have the same preference. Appendix B.4 reports the results from a mixed logit model which relaxes these two assumptions and finds the same qualitative results, so I will use the simpler

Table 2.1: Frequencies of the patterns by pairs of allocations and by setting.

$(x_P, x_\$)$	(£5, £6)	(£5, £7)	(£5, £8)	(£5, £9)	(£5, £10)	Total
<i>Faculty</i>						
Consistent for P-a	6	4	1	2	0	13
Consistent for \$-a	4	6	7	7	10	34
Standard preference reversal	9	9	10	10	10	48
Counter preference reversal	1	1	2	1	0	5
<i>Total</i>	20	20	20	20	20	100
<i>Charity</i>						
Consistent for P-a	10	7	6	4	4	31
Consistent for \$-a	6	7	9	10	10	41
Standard preference reversal	1	3	0	1	2	7
Counter preference reversal	0	1	2	2	1	6
<i>Total</i>	17	17	17	17	17	85

IOS/IIS(P-a) > IOS/IIS(\$-a)
controlling for charity knowledge

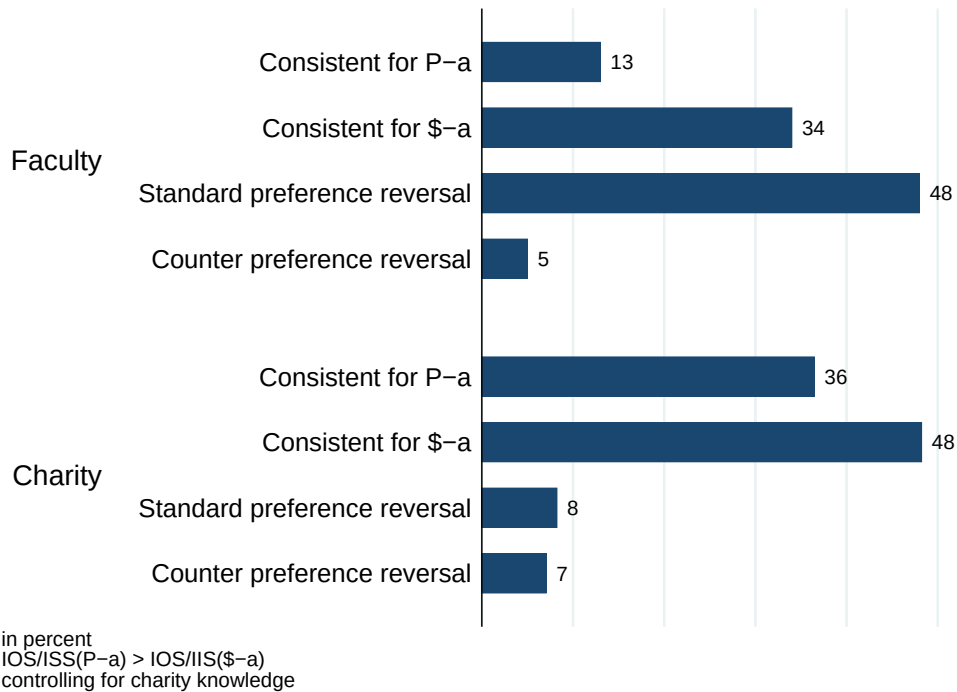


Figure 2.3: The preference reversal phenomenon exists only in the Faculty setting.

Table 2.2: Results from a conditional logit model.

$$U_i = \beta_x x_i + \beta_s s_i + \epsilon_i$$

	Faculty		Charity	
	Choice Coef. (SE)	Valuation Coef. (SE)	Choice Coef. (SE)	Valuation Coef. (SE)
x_i (£)	0.104 (0.059)	0.619*** (0.122)	0.292*** (0.081)	0.444*** (0.120)
s_i (IOS/IIS)	0.264* (0.121)	0.002 (0.128)	0.567** (0.197)	0.652* (0.270)
Observations	550	510	520	444
Log-likelihood	-181.766	-101.934	-152.048	-114.049
Wald χ^2	6.280	26.411	14.424	13.742
Prob > χ^2	0.043	0.000	0.001	0.001
BIC	376.152	216.336	316.603	240.290
Likelihood ratio index	0.046	0.423	0.156	0.259

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

standard errors clustered on subjects' ID

conditional logit model here.

Table 2.1 presents the estimation results. Notice that, except for valuation in the Faculty setting, the coefficient of the IOS or IIS score is positive and significant: when the recipient receives a higher score, the allocation is more likely to be selected. So, the IOS and IIS scales capture a dimension of the allocations having a real impact on behaviour, which validates their use. It also confirms the findings from the social discounting literature.

We make two other observations. Recall that an allocation is characterised by two attributes: money and social distance.

Result 2. *In both settings, $\beta_x^{\text{valuation}}/\beta_s^{\text{valuation}} > \beta_x^{\text{choice}}/\beta_s^{\text{choice}}$: money weighs more in valuation than in choice.*

This result is a classical finding of preference reversal experiments, known

as the *scale compatibility hypothesis* (Tversky et al., 1988)⁷. It says that any task has a response mode and that the weight of an attribute is enhanced by its compatibility with the response mode. The response mode of the valuation task is an amount of money, so the valuation task emphasizes the money attribute of the allocation. The rationale for this effect is that the response mode focuses attention on the compatible attribute.

Despite observing scale compatibility effects in the two settings,

Result 3. *In the Faculty setting, $\beta_s^{valuation}$ is not different from 0: subjects do not consider the social distance attribute in valuation.*

In the Faculty setting, subjects disregard the social distance attribute. Since the payment in the \$-allocation $x_\$$ is greater than the payment in the P-allocation x_P , subjects automatically reveal a preference for the \$-allocation in the valuation task. If they choose the P-allocation in the choice task, they reverse their preference. We also see that for these subjects β_x^{choice} is not different from 0: subjects do not consider the money attribute in choice. For them, choice is lexicographic with respect to the social distance attribute and valuation is lexicographic with respect to the payment attribute (Tversky et al., 1988). Subjects in the Charity setting do not exhibit this effect.

2.4.2 Social distances

Finally, we look at the IOS and IIS scores reported in the Circle task.

Result 4. *Based on the IOS and IIS scores, the perceived difference between the recipient of the P-allocation and the recipient of the \$-allocation is greater in the Charity setting.*

Figure 2.4 reports the average IOS and IIS scores in each setting and Table 2.3 tests the significance of the differences. We see that in the Faculty setting, the member of the Faculty of Social Sciences and the member of the Faculty of Engineering receive similar IOS scores. The difference is only

⁷See also Slovic et al. (1990); Tversky et al. (1990).

2 Preference reversals in the social domain

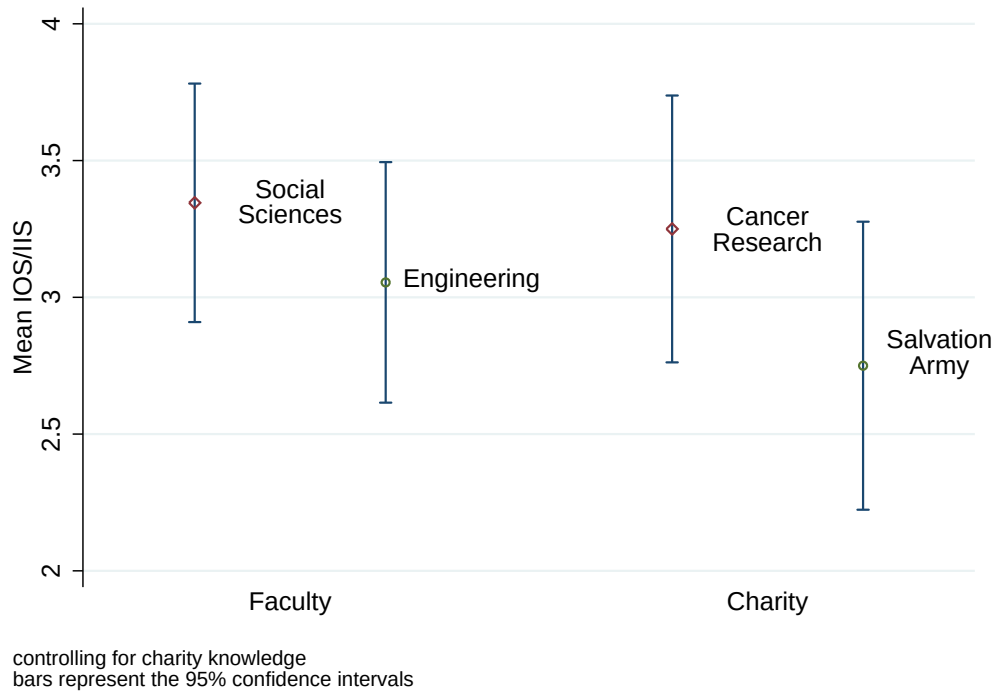


Figure 2.4: On average, the recipient of the P-allocation received a higher IOS or IIS score than the recipient of the \$-allocation.

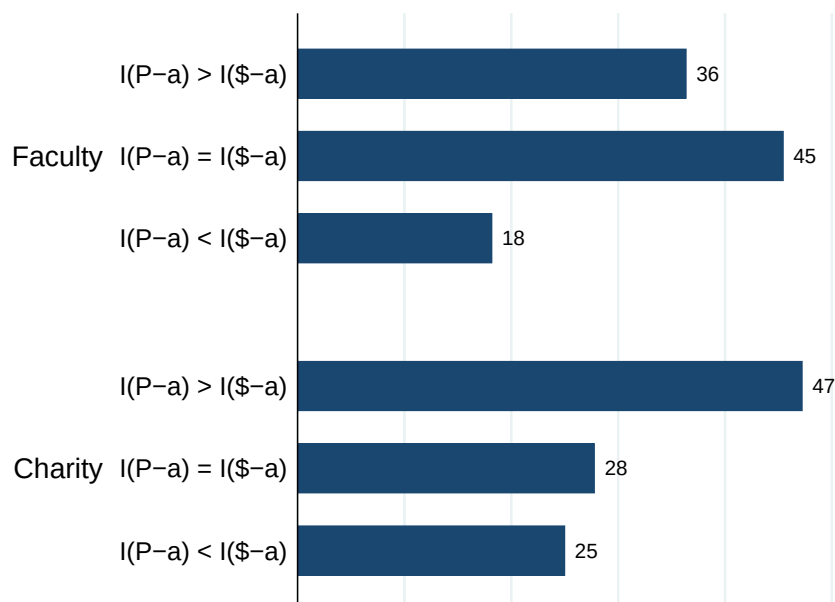
weakly significant with the Wilcoxon signed-rank test. On the other hand, in the Charity setting, The Salvation Army receives lower IIS scores than Cancer Research UK and the difference is statistically significant with the *t*-test and the Wilcoxon signed-rank test.

The same conclusion is reached at the individual level. Figure 2.5 classifies subjects depending on the ranking of the IOS or IIS scores reported. In the Faculty setting, most subjects perceive the member of the Faculty of Social Sciences and the member of the Faculty of Engineering as being equally distant from themselves. Only 40% of the subjects feel the former is closer than the latter. Compared with the Charity setting, Cancer Research UK is closer than The Salvation Army for almost 50% of the subjects, and only 28% perceive them as being equally distant.

As an aside, the IOS and IIS scores obtained in the present study are in

Table 2.3: Summary statistics and tests of difference between IOS (in the Faculty setting) or IIS (in the Charity setting) reported for the recipients of the P-allocation and the \$-allocation.

	IOS/IIS(P-a)		IOS/IIS(\$ -a)		Paired <i>t</i> -test*		Wilcoxon signed-rank test**	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i> -statistic	<i>p</i> -value	<i>z</i> -statistic	<i>p</i> -value
Faculty	3.35	1.61	3.05	1.63	1.21	0.116	1.68	0.092
Charity	3.25	1.44	2.75	1.56	1.90	0.033	1.91	0.056



I = IOS in Faculty setting, IIS in Charity setting
in percent
controlling for charity knowledge

Figure 2.5: More subjects perceived the recipients to be dissimilar in the Charity setting than in the Faculty setting.

line with the literature (see Appendix B.5 for a comparison), which reinforces their reliability.

2.4.3 Discussion

According to Lichtenstein and Slovic (1971), reporting a valuation triggers the following mental procedure: start from the amount of money in the object to evaluate, then incorporate the information from the non-monetary attribute until a valuation is found. This procedure, confirmed experimentally by Schkade and Johnson (1989), gives rise to scale compatibility effects. In pairwise choice, the attributes of the alternatives can be directly compared, so the procedure is different. The difference provides the rationale behind preference reversals.

In the case of the P- and \$-allocations, the valuation procedure would be: start from the amount of money x_P or $x_\$$, then incorporate the social distance. This procedure might explain why we observe preference reversals only in the Faculty setting. Subjects start the experiment knowing that the allocations will benefit a member of the Faculty of Social Sciences or a member of the Faculty of Engineering. We see that these recipients are only weakly dissimilar, thus the social distance attribute of the allocations does not carry much strategic information. When valuations are reported, there is little information to incorporate to the money attribute. On the other hand, the social distance is important in the Charity setting. Subjects consider it in their choice and in their valuation which, in contrast with subjects in the Faculty setting, allows them to be consistent between the two tasks.

2.5 Conclusion

Preference reversals emerged as a way of testing the explicit and implicit assumptions of expected-utility theory. Since then, preference reversals have been observed in many other situations. The present study contributes

to the idea that “the preference reversal phenomenon is an example of a general pattern, rather than a peculiar characteristic of choice between bets” (Tversky and Thaler, 1990). Preference reversals are ubiquitous, which calls into question the assumption of context-independent preferences.

To explain why there are preference reversals in the Faculty setting and not in the Charity setting, I have relied on an ex-post interpretation, which calls for an experiment designed to test it. For example, using more than two charities to vary the social distance would be a logical next step.

Preference reversals mean that preferences can be altered by how they are elicited. This implication is worrisome when payments to close and distant recipients are involved. A government trying to elicit its citizen’s preferences toward the redistribution of resources might get different responses depending on how the policy is presented. A researcher conducting a contingent valuation study of policies affecting segments of the population would make different recommendations depending on how the study is framed to the participants. The results presented in this paper should be kept in mind in such situations.

Testing the asymmetric dominance effect and its explanations

The asymmetric dominance effect occurs when, in the choice between options A and B , adding a third option C dominated by A but not by B increases the choice probability of A . This effect puts into question the basic assumptions of rational choice theory, such as the independence of irrelevant alternatives. In a laboratory experiment, I find the asymmetric dominance effect using gambles and replicate the results from Herne (1999) with: higher incentives; within- and between-subject comparisons; a physical randomisation device; and a more concrete incentive mechanism. The effect is, however, smaller than previously thought, vanishes easily, and even disappears when targeting risky low-probability, high-payoff gambles. My results also point to the existence of a range effect operating against the asymmetric dominance effect, which causes subjects to put more weight on an attribute when its range increases.¹

Keywords: asymmetric dominance effect, decoy effect, range effect, risky choice, individual decision-making

JEL codes: C91, D03, D11, D80

3.1 Introduction

The asymmetric dominance effect is one of the most studied topics in the consumer behaviour and marketing literatures. This effect refers to the

¹I am grateful to Kian Howe Ong, Till Weber, Jingcheng Fu, and especially Ashira Perera, for helping me to conduct the sessions. I thank Daniel Seidmann and Chris Starmer for comments on earlier versions.

3 Testing the asymmetric dominance effect and its explanations

situation in which adding an option C to the choice between A and B , when C is dominated by A but not by B , increases the choice probability of A . From its discovery by Huber et al. (1982), researchers have observed asymmetric dominance in a large variety of settings². Despite the research going back more than 30 years, it is very much alive, as illustrated by the recent debate within the pages of the *Journal of Marketing Research*, in which Frederick et al. (2014) and Yang and Lynn (2014) failed to replicate the asymmetric dominance effect, which sparked replies from Huber et al. (2014) and Simonson (2014)³. To quote Huber et al. (2014), “the attraction effect (originally reported in a consumer behavior journal) may be the one biggest exports from marketing research to other fields in the social sciences precisely because of its theoretical implications”.

Yet, the export has not fully reached economics. There is only one empirical study in the economics literature which investigates asymmetric dominance: Herne (1999), using gambles and improving upon Wedell (1991) by using real incentives⁴. It is sometimes mentioned in theoretical studies, but mostly in passing⁵. This scarcity is surprising given that the effect violates the basic assumptions of rational choice theory. If the choice between two options changes when a third irrelevant option is added, then the independence of irrelevant alternatives does not hold, and most theories will fail to accurately model behaviour.

My goal is to replicate the results from Herne (1999), as well as pulling

²See Heath and Chatterjee (1995); Milberg et al. (2014) and Sivakumar (2016, Appendix 1) for reviews.

³See also Lichters et al. (2015a,b).

⁴Kroll and Vogt (2012) also study decoys in an incentivised setting but they focus on the impact of the added option on certainty equivalents. Incentivised studies of asymmetric dominance with realised outcomes are rare even outside economics: only Simonson and Tversky (1992), Doyle et al. (1999) and Lichters et al. (2015a) fit this description, but none use gambles.

⁵The only theoretical paper focused on asymmetric dominance is Ok et al. (2011), in which the authors investigate its impact on a model of vertical product differentiation. It is then mentioned in Barbos (2010), Blavatskyy (2012), de Clippel and Eliaz (2012), Masatlioglu and Uler (2013), Bordalo et al. (2013) and Gerasimou (2016) as one phenomenon being captured by their models.

apart some explanations of the asymmetric dominance effect. I stress-test her results by using incentives about twice as high, a physical randomisation device to play out the gambles, and a more transparent incentive mechanism (PRINCE, Johnson et al., 2015). The results generally replicate, but I find a much lower asymmetric dominance effect. Especially, I find that the effect depends on the type of gamble targeted: only low-payoff, high-probability gambles are affected by dominating their asymmetrically-dominated options; riskier high-payoff, low-probability gambles are not. I also find evidence of a range effect running against the asymmetric dominance effect. This range effect is left to operate alone when the asymmetric-dominance characteristic of the added options is removed.

But before going to these results, I need to take a step back and introduce in the next Section the asymmetric dominance effect in more detail. Section 3 will then present the experimental design and Section 4 the results.

3.2 The asymmetric dominance effect

The study of the asymmetric dominance effect starts with the choice between two options defined by two dimensions. Each option is superior in one dimension but worse in the other, so that no option outright dominates. Reflecting the origins of the effect in the consumer behaviour literature, the options traditionally studied are consumption goods, such as cars, beers or TV sets. Then, a ‘decoy’, an option that theoretically has no impact on the original choice, is added to the choice set. The asymmetric dominance effect occurs when an asymmetrically-dominated decoy, a decoy dominated by only one of the two original options, increases the choice probability of the dominating option.

I follow Wedell (1991) and Herne (1999) and study this effect with gambles. I focus on simple gambles offering a probability p of winning $\pounds x$ and a probability $1 - p$ of winning $\pounds 0$, denoted by (x, p) . Consider two such gambles: $\omega_1 = (x_1, p_1)$ and $\omega_2 = (x_2, p_2)$. ω_1 is superior in the probability-to-

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win attribute, $p_1 > p_2$, while ω_2 is superior in the amount-to-win attribute, $x_2 > x_1$. The asymmetrically-dominated decoy ω'_1 is dominated by ω_1 but not by ω_2 . These, and all subsequent options, are represented in Figure 3.1.

Over the years, researchers have proposed many explanations to the asymmetric dominance effect, which can be organised in two broad categories (Herne, 1996; Köhler, 2007; Wedell, 1991). Some argue that introducing a decoy changes the way people perceive the attributes constituting the options. For example, Huber et al. (1982) would explain an asymmetric dominance effect resulting from the introduction of ω'_1 as follows⁶. In the initial choice between ω_1 and ω_2 , the range of winning amounts is Δ_x . Introducing the decoy ω'_1 increases this range to Δ'_x . Based on Parducci's (1974) range-frequency theory, the difference in winning amounts between ω_1 and ω_2 now appears smaller due to this range extension, which softens the disadvantage of ω_1 in term of the winning amount. Thus, its superiority in winning probability shines, leading people to choose it more often.

The second category of explanation states that adding a decoy fundamentally changes how people make a decision. In doing so, the option dominating the decoy is perceived as being superior, without affecting the underlying dimensions. Take Simonson's (1989) 'choice based on reasons' approach⁷. Experiments on asymmetric dominance are usually set up so that subjects are initially indifferent between the two options and do not have a clear preference. Adding the decoy ω'_1 introduces a fundamental difference between ω_1 and ω_2 : ω_1 is now in a dominating position while ω_2 is not. So, ω'_1 gives subjects a good justification to choose ω_1 .

To discriminate between the two explanations, I use the decoys ω''_1 and ω^*_1 . ω''_1 is again asymmetrically-dominated, but its introduction doubles the money range. If the range-extension explanation has any bite, then the asymmetric-dominance effect should be greater with ω''_1 compared to ω'_1 . This comparison offers a direct test of one of the conclusions of Heath and

⁶A similar explanation can be found in Simonson and Tversky (1992) and Tversky and Simonson (1993).

⁷For a similar reasoning, see Ariely and Wallsten (1995) and Hedgcock and Rao (2009).

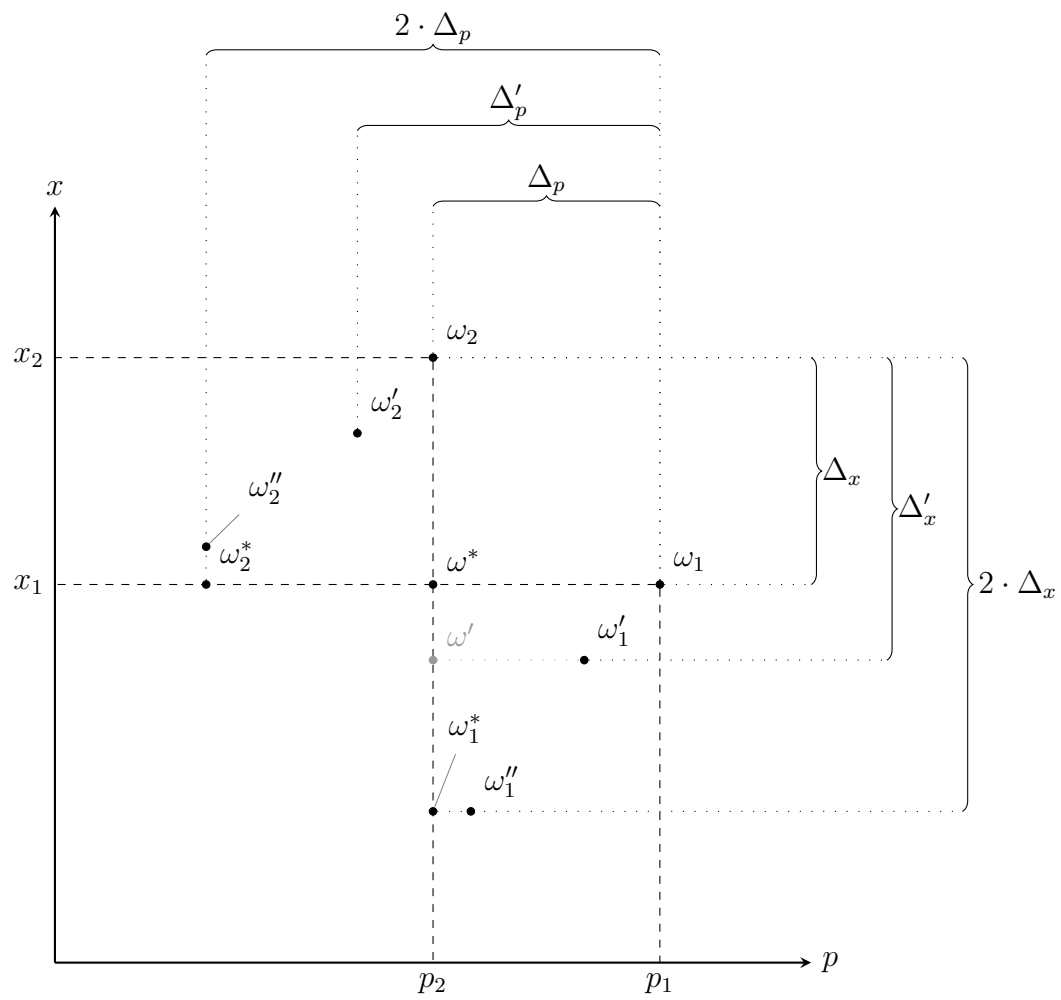


Figure 3.1: Gambles and decoy types.

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Chatterjee's (1995) meta-analysis: the greater the range extension in an asymmetric-dominance setting, the more pronounced the decoy effect.

ω_1^* then removes the asymmetric-dominance aspect of ω_1'' while keeping its range extension, so it removes the change-of-process argument. An increase in the choice probability of ω_1 after the introduction of ω_1^* would verify an explanation of the asymmetric dominance effect based on range extension only. However, note that the model I have presented in Chapter 1 predicts exactly the opposite: introducing ω_1^* increases the range of the money attribute which attracts attention to it and favours ω_2 . Thus, ω_1^* also allows me to discriminate between the range-extension explanation derived from range-frequency theory and my own model.

Wedell (1991, Experiment 2) followed a similar approach by using the decoy ω' , which removes the asymmetric-dominance aspect of ω_1' . He found that adding ω' has no effect and so concluded against the range-extension explanation, which subsequent studies (Wedell, 1998; Wedell and Pettibone, 1996) tended to confirm. Wedell, however, did not give the range-extension explanation a lot of chance to succeed. For example, he used $\omega_1 = (\$20, 0.5)$, $\omega_2 = (\$33, 0.3)$ and $\omega' = (\$18, 0.3)$. With these, the money range increases from $\Delta_x = 33 - 20 = \$13$ to $\Delta'_x = 33 - 18 = \$15$, so the range extension is minimal. It is entirely possible for the range extension to work, but only for the greater extensions created by ω_1'' and ω_1^* .

Moreover, notice that, without the decoy, choice is between two options, while the presence of the decoy involves choosing between three options. This difference could in itself cause a preference shift. I use the neutral decoy ω^* to test for this effect. ω^* does not increase a range and it is symmetrically-dominated, so both the range-extension and the change-of-process explanations predict that it has no impact.

Denote by $\tilde{\omega}_1 \in \{\omega_1', \omega_1'', \omega_1^*\}$ all of the decoys seen so far. To complement these, I will also study the decoys related to ω_2 : $\tilde{\omega}_2 \in \{\omega_2', \omega_2'', \omega_2^*\}$. Again, you are again encouraged to refer to Figure 3.1 which represents all of these decoys. The experiment combines between- and within-subject comparisons.

In a *between-subject comparison*, a first group of subjects chooses one option from $C = \{\omega_1, \omega_2\}$ and a second group from $\tilde{C}_1 = \{\omega_1, \omega_2, \tilde{\omega}_1\}$ or $\tilde{C}_2 = \{\omega_1, \omega_2, \tilde{\omega}_2\}$. There is a decoy effect if the proportion of subjects choosing ω_i increases between C and $\tilde{C}_i$. In a *within-subject comparison*, a given subject chooses both from $\tilde{C}_1$ and $\tilde{C}_2$. Here, there is a decoy effect if the proportion of subjects who choose ω_i when facing $\tilde{C}_i$ and ω_j when facing $\tilde{C}_j$, is greater than the proportion of subjects who choose ω_j when facing $\tilde{C}_i$ and ω_i when facing $\tilde{C}_j$. Wedell (1991) and Herne (1999) only studied the effect within-subject. Instead, I will combine both in the same experiment.

Table 3.1 summarises decoys used in the experiment and the predictions of the two explanations of the asymmetric dominance effect, grouped into four hypotheses:

- H1 tests for the classical asymmetric dominance effect from Herne (1999)
- H2 keeps the asymmetric dominance but increases further the attribute ranges
- H3 removes the asymmetric dominance and lets the range extension operate alone, which also serves as a test of the model of Chapter 1
- H4 focuses on the effect of adding or removing a completely irrelevant option

The next Section presents the experimental design to implement the decoys and their corresponding hypotheses in the laboratory.

3.3 Experimental design

3.3.1 Parameter sets, between- and within-subject comparisons

I started by creating 14 sets of gambles. In each set, the expected value of ω_2 is 20% higher than the one of ω_1 . For the first 11 sets, the expected values of ω_1 and ω_2 are approximately £5.8 and £7; for the remaining 3

Table 3.1: Decoys and their predicted effects.

	Decoy	Category of explanation	Prediction
H1	ω'_1	Range-extension, change-of-process	Increase choice probability of ω_1
	ω'_2	Range-extension, change-of-process	Increase choice probability of ω_2
H2	ω''_1	Range-extension	Increase choice probability of ω_1 , more than ω'_1
	ω''_2	Change-of-process	Increase choice probability of ω_1
		Range-extension	Increase choice probability of ω_2 , more than ω'_2
		Change-of-process	Increase choice probability of ω_2
H3	ω^*_1	Range-extension	Increase choice probability of ω_1 , as much as ω''_1
	ω^*_2	Change-of-process	No effect
		Range-extension	Increase choice probability of ω_2 , as much as ω''_2
		Change-of-process	No effect
H4	ω^*	Range-extension, change-of-process	No effect

Table 3.2: Parameter sets.

Set	ω_1		ω_2		ω^*		ω'_1		ω'_2		ω''_1		ω''_2		ω_1^*		ω_2^*	
	p_1	x_1	p_2	x_2	p^*	x^*	p'_1	x'_1	p'_2	x'_2	p''_1	x''_1	p''_2	x''_2	p_1^*	x_1^*	p_2^*	x_2^*
<i>a</i>	0.8	7	0.55	12.5	0.55	7	0.75	6	0.5	11.5	0.6	1.5	0.3	8	0.55	1.5	0.3	7
<i>b</i>	0.75	7.5	0.55	12.5	0.55	7.5	0.7	6.5	0.5	11.5	0.6	2.5	0.35	8.5	0.55	2.5	0.35	7.5
<i>c</i>	0.75	7.5	0.5	14	0.5	7.5	0.7	6.5	0.45	13	0.55	1	0.25	8.5	0.5	1	0.25	7.5
<i>d</i>	0.7	8	0.5	14	0.5	8	0.65	7	0.45	13	0.55	2	0.3	9	0.5	2	0.3	8
<i>e</i>	0.7	8	0.45	15.5	0.45	8	0.65	7	0.4	14.5	0.5	0.5	0.2	9	0.45	0.5	0.2	8
<i>f</i>	0.65	8.5	0.5	14	0.5	8.5	0.6	7.5	0.45	13	0.55	3	0.35	9.5	0.5	3	0.35	8.5
<i>g</i>	0.65	8.5	0.45	15.5	0.45	8.5	0.6	7.5	0.4	14.5	0.5	1.5	0.25	9.5	0.45	1.5	0.25	8.5
<i>h</i>	0.6	9.5	0.5	14	0.5	9.5	0.55	8.5	0.45	13	0.55	5	0.4	10.5	0.5	5	0.4	9.5
<i>i</i>	0.6	9.5	0.45	15.5	0.45	9.5	0.55	8.5	0.4	14.5	0.5	3.5	0.3	10.5	0.45	3.5	0.3	9.5
<i>j</i>	0.6	9.5	0.4	17	0.4	9.5	0.55	8.5	0.35	16	0.45	2	0.2	10.5	0.4	2	0.2	9.5
<i>k</i>	0.5	11.5	0.3	22.5	0.3	11.5	0.45	10.5	0.25	21.5	0.35	0.5	0.1	12.5	0.3	0.5	0.1	11.5
<i>l</i>	0.75	13.5	0.5	25	0.5	13.5	0.7	12.5	0.45	24	0.55	2	0.25	14.5	0.5	2	0.25	13.5
<i>m</i>	0.7	14.5	0.45	27.5	0.45	14.5	0.65	13.5	0.4	26.5	0.5	1.5	0.2	15.5	0.45	1.5	0.2	14.5
<i>n</i>	0.65	15.5	0.5	24.5	0.5	15.5	0.6	14.5	0.45	23.5	0.55	6.5	0.35	16.5	0.5	6.5	0.35	15.5

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sets, they are £10 and £12. By contrast, Herne's (1999) gambles were all of the same expected value of 30 Finnmarks, which was approximately £3.3 in 1999⁸.

Each set accommodates all decoy gambles mentioned in the previous section so that all sets have the same underlying structure. Accomodating ω_1^* and ω_2^* imposes the most restrictions. For example, $\omega_1 = (£7.2, 0.8)$ and $\omega_2 = (£23, 0.3)$ cannot be part of a valid set: the probability range is $\Delta_p = 0.8 - 0.3 = 0.5$ and it is impossible to introduce a ω_2^* that doubles it. The resulting 14 sets are presented in Table 3.2.

Then, of the first 11 low-stake sets (sets a to k), I randomly assigned 3 to H1, 3 to H2 and 5 to H3, making sure that the sets assigned to an hypothesis were not too similar. I also randomly assigned the 3 remaining high-stake sets to H1, H2 or H3.

For a given parameter set, subjects were split into 4 groups corresponding to the 4 possible choice sets: $C = \{\omega_1, \omega_2\}$, $C^* = \{\omega_1, \omega_2, \omega^*\}$, $\tilde{C}_1 = \{\omega_1, \omega_2, \tilde{\omega}_1\}$ or $\tilde{C}_2 = \{\omega_1, \omega_2, \tilde{\omega}_2\}$. For example, for H1, $\tilde{\omega}_1 = \omega'_1$ and $\tilde{\omega}_2 = \omega'_2$. In a first decision booklet, subjects faced all 14 parameter sets. Table 3.3 shows the order of the parameter sets and choice sets for a given group. C and C^* act as fillers between $\tilde{C}_1$ and $\tilde{C}_2$ so that a subject: (a) does not face the same type of decoy twice in a row; (b) does not face decoys favouring the same option twice in a row. Note that all subjects encounter the parameter sets in the same order.

Subjects faced again all 14 sets in a second decision booklet, which is in the second part of Table 3.3. In this second booklet, a subject chooses from the choice set complementary to the one she encountered in the first booklet: C^* if she faced C and C if she faced C^* , $\tilde{C}_2$ if she faced $\tilde{C}_1$ and $\tilde{C}_1$ if she faced $\tilde{C}_2$. The second booklet was handed out to a subject as soon as she raised her hand to indicate that she was finished with the first booklet. The first booklets were collected before distributing the second booklets, so that subjects could not compare their choices.

⁸Source: <http://www.xe.com/currencytables/?from=FIM&date=1999-08-01>

Table 3.3: Procedure of the experiment.

Set	Group 1	Group 2	Group 3	Group 4
<i>Booklet 1</i>				
g	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega_1^*$	$+\omega_2^*$
c	$+\omega_1^*$	$+\omega_2^*$	$\{\omega_1, \omega_2\}$	$+\omega^*$
f	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega'_2$	$+\omega'_1$
k	$+\omega'_2$	$+\omega'_1$	$+\omega^*$	$\{\omega_1, \omega_2\}$
j	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega''_1$	$+\omega''_2$
m	$+\omega''_1$	$+\omega''_2$	$\{\omega_1, \omega_2\}$	$+\omega^*$
b	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega_2^*$	$+\omega_1^*$
h	$+\omega_2^*$	$+\omega_1^*$	$+\omega^*$	$\{\omega_1, \omega_2\}$
a	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega'_1$	$+\omega'_2$
n	$+\omega'_1$	$+\omega'_2$	$\{\omega_1, \omega_2\}$	$+\omega^*$
i	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega''_2$	$+\omega''_1$
e	$+\omega''_2$	$+\omega''_1$	$+\omega^*$	$\{\omega_1, \omega_2\}$
d	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega_1^*$	$+\omega_2^*$
l	$+\omega_1^*$	$+\omega_2^*$	$\{\omega_1, \omega_2\}$	$+\omega^*$
<i>Booklet 2</i>				
g	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega_2^*$	$+\omega_1^*$
c	$+\omega_2^*$	$+\omega_1^*$	$+\omega^*$	$\{\omega_1, \omega_2\}$
f	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega'_1$	$+\omega'_2$
k	$+\omega'_1$	$+\omega'_2$	$\{\omega_1, \omega_2\}$	$+\omega^*$
j	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega''_2$	$+\omega''_1$
m	$+\omega''_2$	$+\omega''_1$	$+\omega^*$	$\{\omega_1, \omega_2\}$
b	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega_1^*$	$+\omega_2^*$
h	$+\omega_1^*$	$+\omega_2^*$	$\{\omega_1, \omega_2\}$	$+\omega^*$
a	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega'_2$	$+\omega'_1$
n	$+\omega'_2$	$+\omega'_1$	$+\omega^*$	$\{\omega_1, \omega_2\}$
i	$\{\omega_1, \omega_2\}$	$+\omega^*$	$+\omega''_1$	$+\omega''_2$
e	$+\omega''_1$	$+\omega''_2$	$\{\omega_1, \omega_2\}$	$+\omega^*$
d	$+\omega^*$	$\{\omega_1, \omega_2\}$	$+\omega_2^*$	$+\omega_1^*$
l	$+\omega_2^*$	$+\omega_1^*$	$+\omega^*$	$\{\omega_1, \omega_2\}$
$+\tilde{\omega}$ means that $\tilde{\omega}$ is added to $C = \{\omega_1, \omega_2\}$ to form $\tilde{C} = \{\omega_1, \omega_2, \tilde{\omega}\}$				

So, a subject makes 28 choices in total, 14 in each booklet. A slice of Table 3.3 provides a between-subject test of one of the hypotheses. An hypothesis is tested 3 (for H1 and H2) or 5 (for H3) times in a given booklet, so 6 or 10 times in total. Then, for a given subject and a given parameter set, comparing the first and the second booklet provides a within-subject test. Thanks to this design, all within-subject comparisons can be made in two situations: from $\tilde{C}_1$ in the first booklet to $\tilde{C}_2$ in the second booklet, and from $\tilde{C}_2$ to $\tilde{C}_1$. Herne (1999), on the other hand, studied the effect only in one direction for a given parameter set.

3.3.2 Incentives and procedure

Herne (1999) used a random number generator on a computer screen to play out the gambles and described the probabilities in general terms. To increase the concreteness and the realism of the experiment, I used a pair of 10-sided dice instead. All subjects had the dice on their desk throughout the experiment and were actively encouraged to examine them. They knew that these would be the dice used to play their chosen gamble at the end of the experiment. Also, as can be seen in Figure 3.2, the tasks described the probability in terms of these dice.

The experiment was incentivised using the PRINCE mechanism (Johnson et al., 2015). This recently-developed mechanism improves upon the classical Becker-DeGroot-Marschak mechanism and random incentive system by adding concreteness and transparency to the choice situation. It was implemented as follows. When subjects entered the laboratory, they were randomly assigned to one of the 4 groups (see Appendix C.1 for pictures of the experiment). Then, they drew a sealed envelope from a box corresponding to their group. In this envelope was a piece of paper describing the entire choice task (of the 28 they would face in the experiment) that would matter to determine their earnings. Subjects kept the sealed envelope on their desk throughout the experiment. The tasks were framed as subjects' instructions to the experimenter (see Figure 3.2). At the end of the exper-

In one of the envelopes, the options are:

	1	80	81	100
P	£7			£0

	1	55	56	100
Q	£12.5			£0

If these options are the ones in my envelope, give me option: (write P or Q in the box)

- writing **P** means that I will receive £7 if the dice throw yields a number from 1 to 80, and £0 otherwise;
- writing **Q** means that I will receive £12.5 if the dice throw yields a number from 1 to 55, and £0 otherwise.

Figure 3.2: A choice task.

iment, the experimenter went to the subject's desk, opened the envelope and flipped through the booklets to find the task described in the envelope. The gamble chosen by the subject in this particular task was then played with the subject's dice by the subject herself and she was paid according to the result of the dice. Subjects were also paid a show-up fee on top of their earnings from the gamble, of which they were not aware at the time they were making their decisions. The instructions (see Appendix C.2) featured detailed examples, none using the gambles subjects would encounter in the experiment, and control questions.

To summarise, the experiment is setup to replicate the asymmetric dominance effects from Herne (1999) with four important modifications: higher incentives and gambles of different expected values; a combination of within- and between-subject comparisons; a physical randomisation device; and a more concrete incentive mechanism. Then, it uses additional decoys to pull apart the range-extension and the change-of-process explanations.

3.4 Results

3.4.1 Generalities

The experiment took place across five sessions between the end of April and the beginning of June 2016 at the CeDEx laboratory in Nottingham. Subjects were recruited using ORSEE (Greiner, 2004). A session lasted 1 hour for an average payment of £11.37 (SD = £7.43). 207 subjects took part in the experiment.

Table 3.4 gives a broad overview of the data. Each subject made 28 choices (14 in each booklet) and two subjects left a task blank, which leaves 5794 choices to exploit. We see that choice was evenly split between ω_1 and ω_2 ; and that the decoys were chosen only 10 times across the whole experiment, so they were never a viable option. These are two of the conditions identified by Huber et al. (2014) to successfully observe asymmetric dominance effects. I will ignore decoy choices in all the remaining analysis.

Table 3.4: Overview of choice proportions with and without the different decoys.

Choice	Proportion (n) of choices given that the decoy is:											
	No decoy	ω^*	ω'_1	ω'_2	ω''_1	ω''_2	ω^*_1	ω^*_2	<i>Total</i>			
ω_1	0.52 (750)	0.53 (769)	0.59 (246)	0.53 (218)	0.66 (272)	0.61 (253)	0.47 (290)	0.51 (314)	0.54 (3112)			
ω_2	0.48 (698)	0.47 (675)	0.40 (165)	0.47 (194)	0.34 (142)	0.39 (161)	0.53 (330)	0.49 (307)	0.46 (2672)			
Decoy	—	0.00 (5)	0.01 (5)	0.00 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (10)			
<i>Total</i>	1 (1448)	1 (1449)	1 (414)	1 (414)	1 (414)	1 (414)	1 (620)	1 (621)	1 (5794)			

Table 3.5: Summary of within-subject comparisons.

Set		Proportion (n) of choice patterns																												
		$\omega_1 \rightarrow \omega_1$		$\omega_2 \rightarrow \omega_2$		$\omega_1 \rightarrow \omega_2$		$\omega_2 \rightarrow \omega_1$		χ^2		$\omega_1 \rightarrow \omega_1$		$\omega_2 \rightarrow \omega_2$		$\omega_1 \rightarrow \omega_2$		$\omega_2 \rightarrow \omega_1$		χ^2										
a	ω'_1 then ω'_2	0.43	(22)	0.33	(17)	0.12	(6)	0.10	(5)	0.09	ω'_2 then ω'_1	0.37	(19)	0.40	(21)	0.08	(4)	0.15	(8)	1.33	ω''_1 then ω''_2	0.56	(28)	0.22	(11)	0.06	(3)	0.16	(8)	2.27 [‡]
f		0.33	(17)	0.46	(24)	0.12	(6)	0.04	(2)	2.00 [†]		0.41	(21)	0.29	(15)	0.02	(1)	0.25	(13)	10.29 ^{†††}		0.61	(31)	0.12	(6)	0.08	(4)	0.20	(10)	2.57 [‡]
k		0.61	(33)	0.11	(6)	0.20	(11)	0.07	(4)	3.27 ^{††}		0.72	(36)	0.12	(6)	0.06	(3)	0.10	(5)	0.50		0.54	(28)	0.35	(18)	0.02	(1)	0.10	(5)	2.67 [‡]
n		0.34	(17)	0.46	(23)	0.08	(4)	0.12	(6)	0.40		0.43	(23)	0.46	(25)	0.04	(2)	0.07	(4)	0.67		0.46	(25)	0.26	(14)	0.13	(7)	0.15	(8)	0.07
Aggregate		0.43	(89)	0.34	(70)	0.13	(27)	0.08	(17)	2.27 [†]		0.48	(99)	0.32	(67)	0.05	(10)	0.14	(30)	10.00 ^{†††}		0.54	(112)	0.24	(49)	0.07	(15)	0.15	(31)	5.57 ^{†††}
e	ω''_1 then ω''_2	0.52	(28)	0.26	(14)	0.13	(7)	0.09	(5)	0.33	ω''_2 then ω''_1	0.56	(28)	0.22	(11)	0.06	(3)	0.16	(8)	2.27 [‡]	ω^*_1 then ω^*_2	0.31	(16)	0.47	(24)	0.08	(4)	0.14	(7)	0.82
i		0.42	(22)	0.38	(20)	0.13	(7)	0.06	(3)	1.60		0.61	(31)	0.12	(6)	0.08	(4)	0.20	(10)	2.57 [‡]		0.36	(18)	0.52	(26)	0.02	(1)	0.10	(5)	2.67 [‡]
j		0.63	(32)	0.18	(9)	0.12	(6)	0.08	(4)	0.40		0.54	(28)	0.35	(18)	0.02	(1)	0.10	(5)	2.67 [‡]		0.61	(31)	0.27	(14)	0.04	(2)	0.08	(4)	0.67
m		0.48	(24)	0.30	(15)	0.06	(3)	0.16	(8)	2.27 [‡]		0.46	(25)	0.26	(14)	0.13	(7)	0.15	(8)	0.07		0.49	(25)	0.25	(13)	0.02	(1)	0.24	(12)	9.31 ^{†††}
Aggregate		0.51	(106)	0.28	(58)	0.11	(23)	0.10	(20)	0.21		0.54	(112)	0.24	(49)	0.07	(15)	0.15	(31)	5.57 ^{†††}		0.30	(16)	0.50	(27)	0.06	(3)	0.15	(8)	2.27 [‡]
b	ω^*_1 then ω^*_2	0.31	(16)	0.47	(24)	0.08	(4)	0.14	(7)	0.82	ω^*_2 then ω^*_1	0.43	(22)	0.33	(17)	0.08	(4)	0.16	(8)	1.33	ω^*_1 then ω^*_2	0.41	(125)	0.41	(126)	0.05	(14)	0.14	(42)	14 ^{††††}
c		0.36	(18)	0.52	(26)	0.02	(1)	0.10	(5)	2.67 [‡]		0.37	(20)	0.44	(24)	0.09	(5)	0.09	(5)	0		0.38	(19)	0.44	(22)	0.06	(3)	0.12	(6)	1
d		0.61	(31)	0.27	(14)	0.04	(2)	0.08	(4)	0.67		0.44	(23)	0.40	(21)	0.06	(3)	0.10	(5)	0.50		0.44	(24)	0.35	(19)	0.13	(7)	0.07	(4)	0.82
g		0.49	(25)	0.25	(13)	0.02	(1)	0.24	(12)	9.31 ^{†††}		0.40	(21)	0.42	(22)	0.04	(2)	0.13	(7)	2.78 ^{††}		0.37	(115)	0.42	(130)	0.10	(32)	0.12	(36)	0.24
h		0.30	(16)	0.50	(27)	0.06	(3)	0.15	(8)	2.27 [‡]		0.10	(5)	0.54	(27)	0.22	(11)	0.14	(7)	0.89		ω^*_1 then ω^*_2	0.41	(125)	0.41	(126)	0.05	(14)	0.14	(42)
l	0.38	(19)	0.44	(22)	0.06	(3)	0.12	(6)	1	0.44	(24)	0.35	(19)	0.13	(7)	0.07	(4)	0.82												
Aggregate		0.41	(125)	0.41	(126)	0.05	(14)	0.14	(42)	14 ^{††††}		0.37	(115)	0.42	(130)	0.10	(32)	0.12	(36)											

' ω'_1 then ω'_2 ' indicates that ω'_1 is added to the choice between ω_1 and ω_2 in the first booklet, and that ω'_1 is added in the second booklet.

$\omega_1 \rightarrow \omega_1$ denotes a subject who chose ω_1 in the first booklet and ω_1 in the second booklet.

McNemar's χ^2 tests. One, two, three and four symbols indicate significance at $\alpha = 0.1, 0.05, 0.01$ and 0.001 .

[†]: *Null*: the proportion of subjects who switch from ω_1 to ω_2 ($\omega_1 \rightarrow \omega_2$) is equal to the proportion of subjects who switch from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$); *Alternative*: the proportion of subjects who switch from ω_1 to ω_2 ($\omega_1 \rightarrow \omega_2$) is greater.

[‡]: *Null*: the proportion of subjects who switch from ω_1 to ω_2 ($\omega_1 \rightarrow \omega_2$) is equal to the proportion of subjects who switch from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$); *Alternative*: the proportion of subjects who switch from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$) is greater.

3.4.2 Decoy effects

I start by addressing the asymmetric dominance effect. The upper-part of Table 3.5 reproduces the within-subject analysis of Wedell (1991) and Herne (1999). Recall that the decoys of interest for this analysis are ω'_1 and ω'_2 . We look at the choice patterns of subject who faced ω'_1 in the first booklet in addition to ω_1 and ω_2 , then ω'_2 in the second; or who faced ω'_2 , then ω'_1 . A subject is represented in one of the four possible choice patterns: She can be consistent, either by choosing ω_1 in both booklets ($\omega_1 \rightarrow \omega_1$) or ω_2 in both booklets ($\omega_2 \rightarrow \omega_2$); or she can reverse her choice between the booklets, either from ω_1 in the first booklet to ω_2 in the second booklet ($\omega_1 \rightarrow \omega_2$), or from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$). For example, the first number of the first column means that, for parameter set a , 43% of subjects (22 subjects) who saw ω'_1 in the first booklet and ω'_2 in the second booklet chose ω_1 in both booklets. When the decoy ω'_1 is seen first, there is an asymmetric dominance effect if the proportion of subjects who switch from ω_1 to ω_2 is greater than the proportion of subjects who switch in the other direction; and when the decoy ω'_2 is seen first, if the proportion of subjects who switch from ω_2 to ω_1 is greater. Table 3.5 shows us that, when ω'_1 is seen first, the asymmetric dominance effect is significant in 2 of the 4 parameter sets; and when ω'_1 is seen first, it is significant in only one of the 4 parameter sets. Almost all reversals are in the right direction so the asymmetric dominance effect is significant at the aggregate level in both cases.

The between-subject analysis reported in the upper-part Table 3.6, however, paints a slightly different picture. In this Table, instead of comparing the choices of a given subject between the two booklets, we compare the choices of two different subjects, each facing different choice situations. A subject can face either a No Decoy situation, where she chooses between ω_1 and ω_2 only, or a Decoy situation, where a decoy is introduced. For example, for the parameter set a , 51% of subjects (53 subjects) chose ω_1 in the absence of ω'_1 , and 53% (55 subjects) chose ω_1 when ω'_1 was introduced. There is an asymmetric dominance effect if the choice proportion of ω_1 increases

Table 3.6: Summary of between-subject comparisons.

Set		Proportion (n) choosing:											
		ω_1					ω_2					χ^2	
		No decoy		Decoy		χ^2	No decoy		Decoy		χ^2		
a	ω'_1	0.51	(53)	0.53	(55)	0.18	ω'_2	0.49	(51)	0.5	(52)	0.04	0.40
f		0.37	(38)	0.56	(58)	$8.98^{\dagger\dagger\dagger}$		0.63	(66)	0.56	(58)	0.78	4.46^{**}
k		0.80	(82)	0.82	(85)	0.15		0.20	(21)	0.27	(28)	1.22	2.23^*
n		0.50	(51)	0.46	(48)	0.23		0.50	(52)	0.54	(56)	0.23	0.00
Aggregate		0.54	(224)	0.59	(246)	$2.78^{\dagger\dagger}$		0.46	(190)	0.47	(194)	0.12	4.03^{**}
e	ω''_1	0.64	(66)	0.68	(71)	0.41	ω''_2	0.36	(37)	0.38	(40)	0.14	1.03
i		0.55	(57)	0.68	(70)	$3.78^{\dagger\dagger}$		0.45	(47)	0.42	(43)	0.25	2.09^*
j		0.55	(57)	0.69	(71)	$4.37^{\dagger\dagger}$		0.45	(47)	0.37	(38)	1.47	0.78
m		0.58	(60)	0.58	(60)	0.01		0.42	(43)	0.38	(40)	0.23	0.32
Aggregate		0.58	(240)	0.66	(272)	$5.24^{\dagger\dagger}$		0.42	(174)	0.39	(161)	0.85	1.88^*
b	ω_1^*	0.41	(43)	0.49	(50)	1.22	ω_2^*	0.59	(61)	0.52	(54)	0.81	0.04
c		0.52	(54)	0.42	(44)	$2.13^{\ddagger}$		0.48	(49)	0.54	(56)	0.81	0.31
d		0.44	(45)	0.59	(61)	$4.98^{\dagger}$		0.56	(58)	0.41	(42)	$4.98^{\dagger\dagger}$	0.00
g		0.47	(49)	0.52	(54)	0.58		0.53	(55)	0.42	(43)	$2.57^{\dagger}$	0.71
h		0.38	(39)	0.30	(31)	1.50		0.62	(64)	0.62	(64)	0.01	1.73^*
l	ω_1^*	0.54	(56)	0.48	(50)	0.82	ω_2^*	0.46	(47)	0.46	(48)	0.01	0.69
Aggregate		0.46	(286)	0.47	(290)	0.05		0.54	(334)	0.49	(307)	$2.44^{\ddagger}$	1.78^*

One-sided χ^2 tests, $df = 1$. One, two and three symbols indicate significance at $\alpha = 0.1, 0.05$ and 0.01 .

[†]: *Null*: the proportion of subjects who choose the target is the same in the No Decoy and the Decoy situations; *Alternative*: the proportion of subjects who choose the target is *greater* in the Decoy situation.

[‡]: *Null*: the proportion of subjects who choose the target is the same in the No Decoy and the Decoy situations; *Alternative*: the proportion of subjects who choose the target is *lower* in the Decoy situation.

^{*}: *Null*: same distribution of choices when ω_1 is target and when ω_2 is target, *Alternative*: ω_1 is chosen more often when it is the target than when ω_2 is the target.

when ω'_1 is introduced, or when the choice proportion ω_2 increases when ω'_2 is introduced. The Table shows us that this effect is almost absent in the between-subject analysis. I detect it only when the decoy is ω'_1 , and only for parameter set f .

Next, I address the explanations of the asymmetric dominance effect. Consider first the decoys ω''_1 and ω''_2 . These decoys are also asymmetrically dominated, but they increase the range of the weakest attribute of their associated option. As we saw in Table 3.1, the range-extension explanation of asymmetric dominance predicts that ω''_1 and ω''_2 have more incidence on choice than ω'_1 and ω'_2 . Table 3.5 confirms this prediction, but only when subjects are first exposed to ω''_2 , then to ω''_1 (middle-right part of the Table). The effect is significant for 3 out of 4 parameter sets, and also significant at the aggregate level. The left part of the Table shows that the effect generally disappears when subjects are first exposed to ω''_1 : it is significant for only one parameter set, and it is actually in a direction opposite of the one predicted by the range-extension explanation. The between-subject comparison of Table 3.6 further confirms that ω''_1 has more incidence than ω'_1 : At the aggregate level, introducing ω''_1 increases the proportion of subjects choosing ω_1 by 8 percentage points, compared to 5 for ω'_1 . ω''_2 , just as ω'_2 , still has no discernible between-subject effect.

The decoys ω^*_1 and ω^*_2 then remove the asymmetric dominance. The range-extension explanation predicts that ω^*_1 increases the choice probability of ω_1 and ω^*_2 increases the choice probability of ω_2 , just as much as ω''_1 and ω''_2 since the range extension is the same; but the change-of-process explanation predicts that the asymmetric dominance effect vanishes because the dominance aspect is removed. The lower-part of Table 3.5 shows that *neither* is correct: Introducing ω^*_1 in the first booklet and ω^*_2 in the second booklet actually makes subjects switch from ω_2 to ω_1 , and not from ω_1 to ω_2 as predicted by range-extension. This effect is significant for 3 out of 6 parameter sets; and since it is always in the right direction, it is highly significant at the aggregate level. Still, introducing ω^*_2 in the first booklet and ω^*_1 in the second booklet has no effect. For the between-subject comparison,

Table 3.7: Summary of within-subject comparisons with ω^* .

Set	Proportion (n) of choice patterns											
	$\omega_1 \rightarrow \omega_1$	$\omega_2 \rightarrow \omega_2$	$\omega_1 \rightarrow \omega_2$	$\omega_2 \rightarrow \omega_1$	χ^2	$\omega_1 \rightarrow \omega_1$	$\omega_2 \rightarrow \omega_2$	$\omega_1 \rightarrow \omega_2$	$\omega_2 \rightarrow \omega_1$	χ^2		
a	$\left\{ \begin{array}{l} \omega_1, \omega_2 \\ \omega^* \end{array} \right\}$	0.36 (18)	0.38 (19)	0.10 (5)	0.16 (8)	0.69	$\left\{ \begin{array}{l} \omega_1, \omega_2, \omega^* \end{array} \right\}$	0.46 (25)	0.39 (21)	0.06 (3)	0.09 (5)	0.50
b		0.30 (16)	0.44 (24)	0.15 (8)	0.11 (6)	0.29		0.32 (16)	0.52 (26)	0.10 (5)	0.06 (3)	0.50
c		0.51 (26)	0.33 (17)	0.04 (2)	0.12 (6)	2		0.31 (16)	0.48 (25)	0.02 (1)	0.19 (10)	7.36***
d		0.35 (17)	0.41 (20)	0.10 (5)	0.14 (7)	0.33		0.41 (22)	0.43 (23)	0.15 (8)	0.02 (1)	5.44**
e		0.50 (26)	0.38 (20)	0.08 (4)	0.04 (2)	0.67		0.63 (32)	0.20 (10)	0.10 (5)	0.08 (4)	0.11
f		0.28 (15)	0.39 (21)	0.13 (7)	0.20 (11)	0.89		0.26 (13)	0.54 (27)	0.14 (7)	0.06 (3)	1.60
g		0.32 (16)	0.44 (22)	0.04 (2)	0.20 (10)	5.33**		0.41 (22)	0.35 (19)	0.07 (4)	0.15 (8)	1.33
h		0.25 (13)	0.60 (31)	0.08 (4)	0.08 (4)	0		0.27 (14)	0.47 (24)	0.10 (5)	0.16 (8)	0.69
i		0.46 (25)	0.30 (16)	0.09 (5)	0.15 (8)	0.69		0.48 (24)	0.34 (17)	0.12 (6)	0.06 (3)	1
j		0.42 (21)	0.40 (20)	0.04 (2)	0.14 (7)	2.78*		0.50 (27)	0.28 (15)	0.09 (5)	0.13 (7)	0.33
k		0.63 (33)	0.23 (12)	0.08 (4)	0.06 (3)	0.14		0.76 (39)	0.08 (4)	0.04 (2)	0.12 (6)	2
l		0.45 (23)	0.27 (14)	0.14 (7)	0.12 (6)	0.08		0.38 (20)	0.48 (25)	0.04 (2)	0.08 (4)	0.67
m		0.57 (29)	0.24 (12)	0.04 (2)	0.12 (6)	2		0.46 (24)	0.42 (22)	0.06 (3)	0.06 (3)	0
n	0.45 (23)	0.31 (16)	0.06 (3)	0.18 (9)	3*	0.42 (22)	0.46 (24)	0.06 (3)	0.06 (3)	0		
Aggregate	0.42 (301)	0.37 (264)	0.08 (60)	0.13 (93)	7.12***	0.43 (316)	0.39 (282)	0.08 (59)	0.09 (68)	0.64		

$\omega_1 \rightarrow \omega_1$ indicates a subject who chose ω_1 in the first booklet and ω_1 in the second booklet.

McNemar's χ^2 tests. One, two and three symbols indicate significance at $\alpha = 0.1, 0.05$ and 0.01 .

Null: the proportion of subjects who switch from ω_1 to ω_2 ($\omega_1 \rightarrow \omega_2$) is equal to the proportion of subjects who switch from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$); *Alternative*: the proportion of subjects who switch from ω_1 to ω_2 ($\omega_1 \rightarrow \omega_2$) is different from the proportion of subjects who switch from ω_2 to ω_1 ($\omega_2 \rightarrow \omega_1$).

Table 3.6 shows us that, for two parameter sets and at the aggregate level, introducing ω_2^* *decreases* the choice probability of ω_2 and so increases the choice probability of ω_1 , in line with the results from the within-subject comparisons. So, instead of favouring ω_2 , ω_2^* actually favours ω_1 . On the other hand, ω_1^* has no consistent effect: it increases the choice probability of ω_1 for parameter set d but decreases it for c ; and the effect cancels out at the aggregate level.

Finally, we look at the decoy ω^* . This decoy neither increases an attribute range nor is it asymmetrically dominated. Table 3.7 reports the within-subject effect of this decoy on choice. The left part of this Table looks at the effect of adding ω^* to the choice between ω_1 and ω_2 and the right part at removing it. We see that adding ω^* makes subjects switch from ω_2 to ω_1 . The effect is only significant for 3 of the 14 parameter sets; but since it is often in the same direction, it is highly significant at the aggregate level. By contrast, removing ω^* does not have a consistent effect. Table 3.8 shows that the effect vanishes in a between-subject comparisons.

3.4.3 Econometric analysis

To perform a more thorough analysis, I apply the model I have developed in Chapter 1, of which I will summarise the main components. The decision-maker faces gambles $\omega_i = (x_i, p_i)$ in a choice set C , and has an undistorted utility function with expected-utility form $U(\omega_i) = p_i \cdot u(x_i)$. But instead of directly maximising U , she is also influenced by the decision context. She starts by considering how the attribute values are distributed in the choice set and forms the spans of attribute Δ_x and Δ_p . One possible formulation for the spans is simply the difference between the maximum and minimum values in the choice set:

$$\Delta_x = \max_{x \in C_x} u(x) - \min_{x \in C_x} u(x),$$

$$\Delta_p = \max_{p \in C_p} p - \min_{p \in C_p} p.$$

Table 3.8: Summary of between-subject comparisons with ω^* .

Set	Proportion (n) choosing ω_1 when:		
	No decoy	Decoy	χ^2
a	0.51 (53)	0.52 (54)	0.02
b	0.41 (43)	0.41 (43)	0.00
c	0.52 (54)	0.48 (49)	0.49
d	0.44 (45)	0.52 (54)	1.41
e	0.64 (66)	0.63 (65)	0.01
f	0.37 (38)	0.44 (46)	1.28
g	0.47 (49)	0.50 (52)	0.24
h	0.38 (39)	0.35 (36)	0.19
i	0.55 (57)	0.61 (63)	0.71
j	0.55 (57)	0.58 (60)	0.18
k	0.80 (82)	0.75 (77)	0.69
l	0.54 (56)	0.50 (51)	0.31
m	0.58 (60)	0.60 (62)	0.21
n	0.50 (51)	0.55 (57)	0.70
<i>Aggregate</i>	0.52 (750)	0.53 (769)	0.62

Two-sided χ^2 tests, $df = 1$. *Null*: the proportion of subjects who choose ω_1 is the same in the No Decoy and the Decoy situations; *Alternative*: the proportion of subjects who choose ω_1 is different between the No decoy and the Decoy situation.

The decision-maker also considers how the gambles relate to one another to detect dominance relations. These two elements are combined in the focus-weighted utility function

$$\tilde{U}(x_i, p_i; \gamma_i) = \gamma_i \cdot p_i^{\Delta_p} u(x_i)^{\Delta_x},$$

in which $\gamma_i > 1$ if the gamble asymmetrically dominates another option – its decoy, and $\gamma_i = 1$ if it does not. As I have shown in Chapter 1, this simple model captures a wide range of phenomena and is particularly suited to explain the effects found in the experiment.

To introduce a stochastic component, I assume that the probability a subject chooses ω_i from C is

$$\Pr(\omega_i) = \frac{\tilde{U}(\omega_i)}{\sum_i \tilde{U}(\omega_i)}. \quad (3.1)$$

To estimate this model, for a subject n choosing alternative i in choice task t , I use the choice probability in the logit model

$$L_{nit}(\mathbb{B}_n) = \frac{\exp(V(\omega_i))}{\sum_i \exp(V(\omega_i))} \quad (3.2)$$

where

$$\begin{aligned} V(\omega_i) = & \beta_{n,d} \mathbb{1}_{i,\text{decoy}} + \left(\beta_{n,p}^{\Delta_p} + \beta_{n,p}^{\Delta'_p} \mathbb{1}_{\Delta'_p} + \beta_{n,p}^{2\Delta_p} \mathbb{1}_{2\Delta_p} \right) \ln p_i \\ & + \left(\beta_{n,x}^{\Delta_x} + \beta_{n,x}^{\Delta'_x} \mathbb{1}_{\Delta'_x} + \beta_{n,x}^{2\Delta_x} \mathbb{1}_{2\Delta_x} \right) \ln x_i \end{aligned}$$

with $\mathbb{1}$ an indicator function equal to 1 if the condition specified in its subscript is verified, and 0 otherwise. For example, $\mathbb{1}_{i,\text{decoy}} = 1$ if alternative i asymmetrically dominates a decoy, and $\mathbb{1}_{i,\text{decoy}} = 0$ if it does not, either because there are no decoy or because the decoy is symmetrically dominated. Also, $\mathbb{1}_{\Delta'_p} = 1$ in case of small extension of the probability range with ω'_2 ; and $\mathbb{1}_{2\Delta_p} = 1$ if the probability range is doubled with ω''_2 or ω^*_2 ; and similarly

3 Testing the asymmetric dominance effect and its explanations

for $\mathbb{1}_{\Delta'_x}$ and $\mathbb{1}_{2\Delta_x}$.

(3.2) is a rearrangement of (3.1) if we set

$$\begin{aligned}\ln \gamma_i &= \beta_{n,d}, \\ \Delta_p &= \beta_{n,p}^{\Delta_p} + \beta_{n,p}^{\Delta'_p} \mathbb{1}_{\Delta'_p} + \beta_{n,p}^{2\Delta_p} \mathbb{1}_{2\Delta_p}, \\ \Delta_x &= \beta_{n,x}^{\Delta_x} + \beta_{n,x}^{\Delta'_x} \mathbb{1}_{\Delta'_x} + \beta_{n,x}^{2\Delta_x} \mathbb{1}_{2\Delta_x},\end{aligned}$$

so $\beta_{n,d}$ captures the effect of introducing an asymmetrically-dominated decoy; $\beta_{n,p}^{\Delta_p}$ captures some form of baseline probability weighting while $\beta_{n,x}^{\Delta_x}$ captures the baseline concavity of u ; and $\beta_{n,p}^{\Delta'_p}$, $\beta_{n,p}^{2\Delta_p}$, $\beta_{n,x}^{\Delta'_x}$ and $\beta_{n,x}^{2\Delta_x}$ capture the effect of increasing the probability or the money range. To see this, denote by $\tilde{\tilde{U}}$ the natural logarithm transformation of $\tilde{U}$, so $\tilde{\tilde{U}}(\omega_i) = \ln \gamma_i + \Delta_p \ln p_i + \Delta_x \ln u(x_i)$ and rewrite (3.1) as

$$\Pr(\omega_i) = \frac{\exp(\tilde{\tilde{U}}(\omega_i))}{\sum_i \exp(\tilde{\tilde{U}}(\omega_i))}.$$

As explained by Stewart et al. (2014), the advantage of using (3.2) instead of maximising (3.1) by maximum-likelihood is that I can use an off-the-shelf mixed logit regression to account for preference heterogeneity and correlation across choice tasks for a given subject.

In the mixed logit model, the vector of subject-specific coefficient $\mathbb{B}_n$ is unobserved for each subject and varies in the population with density $f(\mathbb{B}_n|\theta)$, where θ are the parameters of the distribution to estimate. I assume that f is the normal distribution, so the parameters to estimate are the mean and the standard deviation of the distribution. The sequence of choices made by subject n conditional on a given $\mathbb{B}_n$ is

$$S_n(\mathbb{B}_n) = \prod_t L_{nit}(\mathbb{B}_n),$$

but we do not know $\mathbb{B}_n$, so we can only write the unconditional probability

of observing this sequence of choice

$$P_n(\theta) = \int S_n(\mathbb{B}_n f(\mathbb{B}_n | \theta)) d\mathbb{B}_n.$$

This unconditional probability generally does not have a closed-form solution and should be approximated with simulation (Train, 2009). The exact process has already been presented in the Appendix of the previous Chapter.

Table 3.9 presents the estimation results. The top part presents the estimates of the mean of the parameters while the bottom presents the estimates of the standard deviations. I estimated three models, all on the whole data: a baseline model (1) without asymmetric dominance and range effects; a model (2) with asymmetric dominance only; and a full model (3) with both asymmetric dominance and range effects. A likelihood-ratio test shows that adding the asymmetric-dominance parameter $\mathbb{1}_{i,\text{decoy}}$ to the baseline model results in a statistically significant increase in model fit ($\chi^2(2) = 12.89$, $p < 0.05$), and adding the range parameters $\mathbb{1}_{\Delta'_p}$, $\mathbb{1}_{2\Delta_p}$, $\mathbb{1}_{\Delta'_x}$ and $\mathbb{1}_{2\Delta_x}$ to the model with asymmetric dominance also results in a statistically significant increase in model fit ($\chi^2(8) = 16.14$, $p < 0.05$).

Looking at the means of model (3), we see that adding an asymmetrically-dominated decoy boosts the utility of the dominating gamble: $\beta_{n,d} = 0.425$ so $\gamma_i \simeq 1.53$. The coefficients of $\ln(p) \times \mathbb{1}_{\Delta'_p}$ and $\ln(p) \times \mathbb{1}_{2\Delta_p}$ are positive and significant, so adding decoys below ω_2 has two effects: it favours ω_2 due to the asymmetric dominance, but it also favours ω_1 by increasing the probability range and so the importance of the probability attribute. Further, the coefficient for $\ln(p) \times \mathbb{1}_{\Delta'_p}$ is greater than the one for $\ln(p) \times \mathbb{1}_{2\Delta_p}$, which means that, since $\ln(p) < 0$, doubling the probability range ($2\Delta_p$) has a bigger impact than moderately increasing it (Δ'_p). On the other hand, adding a decoy below ω_1 only causes an asymmetric dominance effect and no range effect, since the coefficients for $\ln(x) \times \mathbb{1}_{\Delta'_x}$ and $\ln(x) \times \mathbb{1}_{2\Delta_x}$ are not statistically significantly different from 0. This corroborates the finding of the previous subsection that ω_2^* increased the choice probability of ω_1 by increasing the probability range, but that ω_1^* caused no effect.

The standard deviation estimates at the bottom of the Table show us that there is little preference heterogeneity, except for $\ln(x)$ whose standard deviation estimate is the only one to be significant, meaning that subjects were attracted to the money attribute to varying degrees.

3.4.4 Discussion

In sum, the experiment replicates the results from Wedell (1991) and Herne (1999), but I find that the asymmetric dominance effect is much lower than previously thought. For example, Herne (1999) found that, on average, almost 29% of subjects exhibited the asymmetric dominance effect. Only 13% do so in my experiment; but I would approach this finding from a different perspective: 13% of subjects' choices were still affected by the asymmetrically-dominated gambles, *despite* the higher incentives, the more transparent incentive mechanism, and the increased concreteness of the choice situation.

Further, I find that ω_1'' causes a stronger asymmetric dominance effect by increasing the choice probability of ω_1 more than ω_1' did, in line with the range-extension explanation. But contrary to the prediction of both the range-extension and the change-of-process explanations, I also find that ω_2^* increases the choice probability of ω_1 , not of ω_2 . ω_2^* increases the range of the probability attribute in which ω_1 is superior and leads subjects to put more weight on the probability attribute. The regression presented in Table 3.9 verifies this result. It is in line with the studies finding that people weight more an attribute when its range is greater (Fischer, 1995; Goldstein, 1990; Mellers and Cooke, 1994; von Nitzsch and Weber, 1993; Wedell, 1998; Wedell and Pettibone, 1996) and provides evidence for the assumption underlying the model I presented in Chapter 1.

So, ω_1' , ω_1'' and ω_2^* increase the choice probability of ω_1 , but as we saw in the between-subject comparisons of Table 3.6, ω_2' , ω_2'' and ω_1^* have no effect on ω_2 . To explain this discrepancy, remember that ω_2 is considerably riskier than ω_1 ; by choosing it, subjects faced a 45-to-70% chance of getting £0

Table 3.9: Results from the mixed logit model.

	Estimates		
	(1) <i>Coef. (SE)</i>	(2) <i>Coef. (SE)</i>	(3) <i>Coef. (SE)</i>
Mean			
$\ln(p)$	13.522*** (0.562)	13.354*** (0.564)	12.725*** (0.586)
$\ln(x)$	8.253*** (0.415)	8.159*** (0.419)	7.855*** (0.431)
$\mathbb{1}_{i,\text{decoy}}$		0.198*** (0.054)	0.425*** (0.088)
$\ln(p) \times \mathbb{1}_{\Delta'_p}$			1.314*** (0.396)
$\ln(p) \times \mathbb{1}_{2\Delta_p}$			0.758** (0.241)
$\ln(x) \times \mathbb{1}_{\Delta'_x}$			0.255 (0.258)
$\ln(x) \times \mathbb{1}_{2\Delta_x}$			0.134 (0.153)
SD			
$\ln(p)$	0.199 (0.767)	0.084 (0.627)	-0.085 (0.581)
$\ln(x)$	1.536*** (0.167)	1.567*** (0.166)	1.542*** (0.166)
$\mathbb{1}_{i,\text{decoy}}$		-0.001 (0.081)	-0.002 (0.083)
$\ln(p) \times \mathbb{1}_{\Delta'_p}$			-0.003 (0.636)
$\ln(p) \times \mathbb{1}_{2\Delta_p}$			-0.017 (0.310)
$\ln(x) \times \mathbb{1}_{\Delta'_x}$			0.010 (0.431)
$\ln(x) \times \mathbb{1}_{2\Delta_x}$			0.022 (0.191)
Observations	15934	15934	15934
Log-likelihood	-3686.327	-3679.881	-3671.810
Wald χ^2	661.705	662.719	662.381
Prob > χ^2	0.000	0.000	0.000
BIC	7411.359	7417.819	7479.086
Likelihood ratio index	0.332	0.334	0.335

Number of Halton draws used for simulation: 1000

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3 Testing the asymmetric dominance effect and its explanations

from the experiment. A decoy targeting ω_2 only attracts attention to the fact that this option could make them leave the experiment empty-handed. As pointed out by Huber et al. (2014), the attraction effect, a superset of the asymmetric dominance effect, might occur only when subjects derive a positive emotion from detecting the relation between the decoy and its target, an hypothesis verified by Heath and Chatterjee (1995) who find in their meta-analysis that the asymmetric dominance effect vanishes when the decoy involves undesirable options. The unattractiveness of ω_2 might also explain why, as we saw in Table 3.7, introducing ω^* made subjects switch from ω_2 to ω_1 . Introducing ω^* gave subjects a second chance to re-evaluate their decisions and, since ω_2 is the risky option, move away from it.

Therefore, ω'_2 , ω''_2 and ω_1^* were seen as truly irrelevant decoys, having no effect on ω_2 . This irrelevance explains why, in the within-subject comparisons of Table 3.5, introducing these decoys in the second booklet caused less or even no effect: There was no reason for subjects to change the choice they established in the first booklet when these irrelevant decoys appeared in the second booklet. On the other hand, encountering the irrelevant decoys in the first booklet leaves the other decoys favouring ω_1 – ω'_1 , ω''_1 and ω_2^* – room to operate in full force when they were introduced later.

These two last results went unnoticed in previous experiments, and they illustrate the importance of combining within- and between-subject designs, as well as studying the introduction of decoys in both directions ($\tilde{\omega}_1$ first vs. $\tilde{\omega}_2$ first) in the same experiment. In fact, Herne's (1999) results support the hypothesis that the asymmetric dominance effect is less pronounced when ω'_2 appears in the second booklet. However, she did not comment on it because, for a given parameter set, she only looked at the effect in one direction.

Finally, Table 3.6 also showed us that the asymmetric dominance effect is lower and almost vanishes in the between-subject comparison. As pointed out by Huber et al. (2014) in their list of factors mitigating the asymmetric dominance effect, this discrepancy might have to do with preference heterogeneity: If half of the subjects exhibits the asymmetric dominance

effect, which causes them to choose the option that dominates the decoy, but the other half exhibits, say, the repulsion effect (Simonson, 2014), which leads them to choose the option that does *not* dominate the decoy; the net effect of introducing the decoy would be 0. Table 3.9 showed us that there exists heterogeneity in the subjects' perception of the winning amount of the gambles. Either this is the cause for the lack of between-subject effect, and it might well be since we already saw that the high-payoff gamble ω_2 was the one not reacting to decoys; or there are other sources of preference heterogeneity, not captured by the model.

3.5 Conclusion

To conclude, the experiment replicates the asymmetric dominance effect, by which an asymmetrically-dominated decoy favours the dominating option. The effect I obtain is lower than in previous experiments (Herne, 1999; Wedell, 1991) but is still observable despite the measures I took. I also find that the type of gamble targeted by the decoys is important: the probability of choosing high-payoff, low-probability gambles tend to react the most to the introduction of decoys, while riskier gambles offering higher payoffs but with lower probabilities do not.

Additionally, I uncover a range effect, by which introducing a decoy can favour the *other*, non-dominating option because the decoy increases the range of the attribute in which it is superior. This result confirms the mechanism behind the model I presented in the first Chapter.

We thus have two effects going in opposite directions. To reconcile them, consider the following hypothesis: The range effect always operates, but is weaker than the asymmetric dominance effect. Removing the asymmetric dominance leaves the range effect to operate alone. If this hypothesis is true, it should be possible to reverse the asymmetric dominance effect with an asymmetrically-dominated decoy that increases the range sufficiently. Doubling the range in the present experiment with ω_1'' and ω_2'' did not prove

3 Testing the asymmetric dominance effect and its explanations

sufficient; greater range extension might prove more successful.

Here, I have looked at decoy effects with gambles; but if my general approach is correct, decoy effects should be observable with delayed payoffs or allocations. As far as I know, decoy effects in the time or the social domain have not been documented – yet.

Conclusion

What have we learnt in the course of these three chapters? The same, simple psychological mechanism – weighting attributes more heavily when their values differ more – can explain the commonality between risky choice and intertemporal choice. It also allows for a formalisation of preference reversals between choice and valuation and, when applied to choice across social distances, the mechanism predicts new anomalies in the social domain. Social preference reversals exist, which adds to the list of similarities between the risk, time and social domain. And, in addition to asymmetric dominance effects, people are prone to range effects, verifying the aforementioned mechanism.

I have solved a number of technical and methodological questions to arrive at these conclusions. The model in the first chapter shows how one can supplement the standard, preference-based approach, in which choice is determined solely by the characteristics of the options the decision-maker is choosing from, with a dose of context-dependence, in which the *other* options in the consideration set also matter. To study preference reversals in the social domain, I have imported and measured real social distances in a controlled laboratory experiment. The experiment presented in the last chapter illustrates the importance of combining within- and between-subject designs.

My work is not without its limitations, however. I have explored only one possible explanation to the similarities between choice under risk, choice over time and choice across social distances. I have taken it as a given, and I have not provided the ‘why’ behind the effects I document. And as with

Conclusion

all experimental endeavours, more data are needed to assess the robustness of my results. For example, my social preference reversal experiment has a modest sample size and use only two specific manipulations of social distance.

With that in mind, I hope it makes a contribution in two areas. First, we have more and more evidence that the situations in which people make decisions might not be as separate as the models we routinely use suggest. Studying risky choice and intertemporal choice as a comprehensive whole is still at the fringe of the literature and the present work shows one way of doing it without relying on too-unconventional assumptions. It might require taking into account the decision context, which runs contrary to the standard preference-based approach, but also opens up new research areas. Second, other disciplines have for a long time acknowledged the importance of social distances in decision-making. Economics has been slow to follow, for a good reason: ‘social distance’ is a nebulous concept, and studying social distances require one to solve a series of methodological questions. My thesis adds to the burgeoning literature answering these questions and attacking the concept head-on, which expands the range of domains to which economics can contribute.

The present work also opens up a few routes for future research. I have predicted other anomalies in choice across social distances such as ‘common social distance’ effect and magnitude effects with allocations. These can be tested, and my experience in dealing with social distances in the laboratory will certainly help. Similarly, if the risk, time and social domain are driven by the same principles, then asymmetric dominance effects should be observable, not only with gambles, but also with delayed outcomes and with allocations. Lastly, expanding the model further by capturing the interactions between the psychological distances, for example when options are risky and delayed, or delayed and for other people, would continue the parallel with construal level theory and provide an explanation to other documented phenomena.

Appendices

Appendix to Chapter 1

A.1 Axiomatisation of U

I consider two-attribute prospects $(x, d) \in X \times D$. x is an amount of money and d a psychological distance, measured from the decision-maker. I will say that (Prelec and Loewenstein, 1991)

Definition. Attribute d has a positive polarity, denoted $d_{(+)}$, when more of this attribute is preferred to less; and a negative polarity, $d_{(-)}$, when less is preferred to more.

I specify the outcome-distance structure by:

Axiom A.1.1 (Structure). X is a real interval and D is either a set of non-negative integers or an interval of non-negative real numbers.

...and introduce the following axioms, adapted from Fishburn and Rubinstein (1982):

Axiom A.1.2 (Rationality). $\succsim$ is complete and transitive.

Axiom A.1.3 (Continuity). $\forall (x, d) \in X \times D$, the sets $\{(x', d') \mid (x', d') \succsim (x, d)\}$ and $\{(x', d') \mid (x, d) \succsim (x', d')\}$ are closed.

Axiom A.1.4 (Monotonicity). If $x' \geq x$ then $(x', d) \succsim (x, d)$.

Axiom A.1.5 (Zero outcome). If $x = 0$ then $(x, d') \sim (x, d)$.

Axiom A.1.6 (Polarity of d). If $d' \geq_{(+)} d$ then $(x, d') \succsim (x, d)$. If $d' \geq_{(-)} d$ then $(x, d') \precsim (x, d)$.

Axiom A.1.7 (Double-cancellation). $\forall x, y, z \in X$ and $d, e, f \in D$, if $(x, d) \sim (y, e)$ and $(y, f) \sim (z, d)$ then $(x, f) \sim (z, e)$.

A.1.1-A.1.7 imply that there is a real-valued function $U(x, d) = f(d)u(x)$ with $u(0) = 0$, u increasing, $f(\frac{d}{+})$ increasing and $f(\frac{d}{-})$ decreasing with $f(d) > 0 \forall d$, such that $\forall (x, d), (x', d') \in X \times D$, $(x, d) \succsim (x', d')$ if and only if $U(x, d) \geq U(x', d')$ (Fishburn and Rubinstein, 1982, Theorem 3).

Appendix to Chapter 2

B.1 Survey

B.1.1 Faculty setting

Respondents were members of the University of Nottingham registered on the subject recruitment system ORSEE (Greiner, 2004). They belonged to one of the five Faculties of the University of Nottingham: the Faculty of Arts, the Faculty of Engineering, the Faculty of Medicine and Health Sciences, the Faculty of Science and the Faculty of Social Sciences. I primed the Faculty membership in the invitation email (see Appendix B.1.1 for a transcript of the invitation email). Respondents verified this information in the first question of the survey, then answered the IOS scale, one for each Faculty (see Appendix B.1.1 for screenshots of the survey). The Faculty membership that we have access to is self-reported; however, respondents had to confirm it twice before they could start the survey and we have no reason to believe that students registered would misreport their Faculty membership. About 45 students in each Faculty (231 in total) participated in this survey.

Invitation email

Dear #fname# #lname#,

We would like to invite you to take part in our upcoming online experiment. If you would like to participate, please click on the link below:

#link#

(If the link does not work, copy it and paste it into the address field of your internet browser.)

This experiment is named **#experiment_name#**. Please include “**#experiment_name#**” in the subject field of any email you send CeDEx regarding this experiment.

You have until November 18 2014 00:00 to complete the survey. If you complete the whole survey, you will enter a prize draw with a chance of winning £10. The prize draw will take place on November 18 2014 at 10am in front of the School of Economics Reception in the Clive Granger Building. You do not need to be present to win the prize. Winners will be contacted by email.

You have been selected to take part in this online experiment because our records indicate that you are a member of the Faculty of [Arts/Engineering/Medicine and Health Sciences/Science/Social Sciences]. If this is not the case, you will have the possibility to indicate your real Faculty membership during the survey. This does not influence your chances of winning the prize.

Best regards,

Geoffrey Castillo

Screenshots

First, respondents confirmed their Faculty membership:

B.1 Survey

Survey on Faculties for members of the Faculty of Arts

0% 100%

Our records indicate that you are a member of the Faculty of Arts.

*** Is this information correct?**

☐ Yes ☐ No

? For information, the Faculty of Arts is composed of the following Schools:

- American and Canadian Studies
- Archaeology
- Art History
- Classics
- Culture, Film and Media
- Cultures, Languages and Area Studies
- English
- French and Francophone Studies
- German Studies
- History
- Humanities
- Language Centre
- Music
- Philosophy
- Russian and Slavonic Studies
- Spanish, Portuguese and Latin American Studies
- Theology and Religious Studies

If they clicked ‘No’, they had a chance to correct this information:

Survey on Faculties for members of the Faculty of Arts

0% 100%

Our records indicate that you are a member of the Faculty of Arts.

*** Please select your Faculty from the list below.
Choose one of the following answers**

☐ Faculty of Engineering

☐ Faculty of Medicine and Health Sciences

☐ Faculty of Science

☐ Faculty of Social Sciences

? For your information, the composition of the other Faculties is as follows.

Faculty of Engineering:

- Architecture and Built Environment
- Chemical and Environmental Engineering
- Civil Engineering
- Foundation Engineering and Physical Sciences
- Electrical and Electronic Engineering
- Mechanical, Materials and Manufacturing Engineering

Faculty of Medicine and Health Sciences:

- Health Sciences
- Life Sciences
- Medicine
- Veterinary Medicine and Science

Faculty of Science:

- Biosciences
- Chemistry
- Computer Science
- Mathematical Sciences
- Pharmacy
- Physics and Astronomy
- Psychology

Faculty of Social Sciences:

- Contemporary Chinese Studies
- Economics
- Education
- Geography
- Law
- Nottingham University Business School
- Politics and International Relations
- Sociology and Social Policy

Finally, they were required to respond to the IOS scale toward a member of each Faculty. The order was randomised for each participant.

Survey on Faculties for members of the Faculty of Arts

0% 100%

Attitude toward members of the different Faculties.

* Please consider the person from the Faculty of Engineering. Select the pair of circles below which best describes how you feel toward this person.

A B C D E F G

○ A ○ B ○ C ○ D ○ E ○ F ○ G

B.1.2 Charity setting

Here, the Faculty membership was not primed (see Appendix B.1.2 for a transcript of the invitation email). We included 39 charities in the survey based on data provided by the Charity Aids Foundation¹. First, respondents had to indicate how familiar they were with each charity. This generated a one-to-four measure of knowledge. Then, the social distance was assessed using the IIS scale for all charities with a reported knowledge equal or greater than 3 (see Appendix B.1.2 for screenshots of the survey). 37 people participated in this survey.

Invitation email

Dear #fname# #lname#,

We would like to invite you to take part in our upcoming online experiment. If you would like to participate, please click on the link below:

#link#

(If the link does not work, copy it and paste it into the address field of your internet browser.)

¹<http://www.charitytrends.org/>, accessed 26 March 2015.

This experiment is named `#experiment_name#`. Please include “`#experiment_name#`” in the subject field of any email you send CeDEx regarding this experiment.

You have until 6 December 2014 00:00 to complete the survey. If you complete the whole survey, you will enter a prize draw with a chance of winning £10. The prize draw will take place on 9 December 2014 at 10am in front of the School of Economics Reception in the Clive Granger Building. You do not need to be present to win the prize. Winners will be contacted by email.

Best regards,

Geoffrey Castillo

Screenshots

First, respondents were asked to report their knowledge for each of the 39 charities. The order was randomised for each respondent.

B Appendix to Chapter 2

Survey on charities

0% 100%

Knowledge of charities

In this section, we will present you several charities and we will ask you how familiar you are with them.

* Please indicate how familiar you are with the following charities.

	I have never heard of it	I have only heard the name	I know the name but I have only a vague idea of what it does	I know the name and I have a good idea of what it does
Cancer Research UK	☐	☐	☐	☐
Shelter National Campaign for Homeless People Limited	☐	☐	☐	☐
WWF - UK	☐	☐	☐	☐
Disasters Emergency Committee	☐	☐	☐	☐
Oxfam	☐	☐	☐	☐
Marie Curie Cancer Care	☐	☐	☐	☐
The Royal British Legion	☐	☐	☐	☐
The Guide Dogs for the Blind Association	☐	☐	☐	☐
Macmillan Cancer Support	☐	☐	☐	☐
Royal Society for the Prevention of Cruelty to Animals	☐	☐	☐	☐
WaterAid	☐	☐	☐	☐
Voluntary Service Overseas	☐	☐	☐	☐
BBC Children in Need	☐	☐	☐	☐
The National Trust for Places of Historic Interest or Natural Beauty	☐	☐	☐	☐
Arthritis Research UK	☐	☐	☐	☐
Tearfund	☐	☐	☐	☐
British Heart Foundation	☐	☐	☐	☐
The Royal National Theatre	☐	☐	☐	☐
Barnardo's	☐	☐	☐	☐
UNICEF - UK	☐	☐	☐	☐
The London Diocesan Fund	☐	☐	☐	☐
Age UK	☐	☐	☐	☐
Christian Aid	☐	☐	☐	☐
The Royal National Institute of Blind People	☐	☐	☐	☐
ActionAid	☐	☐	☐	☐
	I have never heard of it	I have only heard the name	I know the name but I have only a vague idea of what it does	I know the name and I have a good idea of what it does
The Salvation Army	☐	☐	☐	☐
The Prince's Trust	☐	☐	☐	☐
The Donkey Sanctuary	☐	☐	☐	☐
Help for Heroes	☐	☐	☐	☐
Royal Commonwealth Society for The Blind	☐	☐	☐	☐
The Save the Children Fund	☐	☐	☐	☐
The National Society for the Prevention of Cruelty to Children	☐	☐	☐	☐
Royal Society for the Protection of Birds	☐	☐	☐	☐
Alzheimer's Society	☐	☐	☐	☐
The Royal National Lifeboat Institution	☐	☐	☐	☐
Catholic Agency for Overseas Development (CAFOD)	☐	☐	☐	☐
The British Red Cross Society	☐	☐	☐	☐
Cats Protection	☐	☐	☐	☐
The Great Ormond Street Hospital Children's Charity	☐	☐	☐	☐

If they indicated 'I know the name but I have only a vague idea of what

it does' or 'I know the name and I have a good idea of what it does', they responded to the IIS scale for this charity. Again, the order was randomised for each participant.

Survey on charities

0% 100%

Attitude toward charities

Please consider the British Red Cross Society. Select the pair of circles below which best describes how you feel toward this charity.

A B C D E F G

☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G

B.2 Experiment

B.2.1 Faculty setting

Invitation email

Dear #fname# #lname#,

You are registered with CeDEx to participate in experiments. We would like to invite you to take part in our upcoming experiment. You are invited to this experiment because our records indicate you are a member of the Faculty of Arts. Please do not sign up to this experiment if this is not the case.

The experiment will take place in the CeDEx computer lab, room C41, Sir Clive Granger Building (University Park). We are planning the following sessions (you can participate in one session only):

#sessionlist#

If you would like to participate, please click on the link below to sign up to the session of your choice. Please note: people that sign up to a session and do not turn up cause us problems; sign up to a session only if you are

sure you can attend it, and if you sign up please do attend. We operate a policy of removing participants from our database who sign up but then fail to turn up (without good reason).

#link#

(If the link does not work, copy it and paste it into the address field of your internet browser.)

Please be on time and remember to bring your Student ID to the session.

This experiment is named **#experiment_name#**. Please include “**#experiment_name#**” in the subject field of any email you send CeDEx regarding this experiment.

Best regards,

Geoffrey Castillo

Instructions

Instructions

Welcome to the experiment. It is composed of two parts: Part 1 and Part 2. You will receive a fixed payment of £5 at the end of the experiment and you will earn more depending on your choices during Part 2. Please remain silent and do not speak with other participants. If you have a question of any kind, please raise your hand at any time and an experimenter will come to your desk.

You have in your possession two envelopes, respectively labelled 'Part 1' and 'Part 2'. They contain the material you will need for this experiment. Please do not open any of the envelopes until instructed to do so by the experimenters.

Before we proceed, we would like you to verify that you are from the Faculty of Arts. If this is the case, please tick the following checkbox:

☐ I acknowledge I am a member of the Faculty of Arts.

If this is not the case, please raise your hand and wait for an experimenter to come to your desk.

We have a lot of procedures in place throughout the experiment designed to ensure your anonymity. The first one is the use of an identification number. This is the number printed at the top of this page. Each of the experimental packages that you saw outside the room had a different identification number. In effect, one of the identification numbers has been randomly attributed to you as you randomly selected one of the experimental packages. Your decisions are linked to this identification number, not to your identity. We are trying our best not to link your decisions to your identity, so please play your part in not allowing anyone—including the experimenters—to see this identification number. For similar reasons, do not write anything on any of the pages that would allow us to identify you.

We will now present Part 1 of the experiment in detail.

Part 1

You will be randomly matched with one participant from the Faculty of Social Sciences and one participant from the Faculty of Engineering. From now on, we will use the expressions 'the member of the Faculty of Social Sciences' and 'the member of the Faculty of Engineering' to refer to the two participants you will be matched with. This matching will be constant throughout the experiment. You will not be told who these people are either during or after the experiment. The only information disclosed is their Faculty membership. Also, they will not be told who you are. As a matter of fact and as explained below, participants from the Faculty of Social Sciences and the Faculty of Engineering will not even know that this experiment took place.

In this part of the experiment, we will give money to the member of the Faculty of Social Sciences or to the member of the Faculty of Engineering depending on your choices. Hence, *the money donated is not your money* and nothing is taken from you.

There are only members of the Faculty of Arts in this room; hence, none of your choices in Part 1 will affect someone in this room nor will their choices affect you.

The experimental material for Part 1 of the experiment is composed of the present instructions and the envelope labelled 'Part 1'. Do not open the envelope until instructed to do so.

We will start by describing the tasks.

Tasks

There will be three types of tasks, which we call **allocation tasks**, **equivalence tasks** and **circle tasks**.

Allocation tasks

Allocation tasks ask you to choose between two alternatives. Here is an example:

Option A: We give £ y to the member of the Faculty of Social Sciences
Option B: We give £ z to the member of the Faculty of Engineering

Choose **A** or **B**:

You will choose one of the two options by writing 'A' or 'B'. There will be a range of such tasks involving different money amounts.

Equivalence tasks

In equivalence tasks, we propose an allocation of a specific amount to either the member of the Faculty of Social Sciences or the member of the Faculty of Engineering. We then ask you to specify how much money we would have to *give to you* instead so that you would think that amount of money was just as good as the proposed allocation. Here is an example:

How much money *given to you* would be just as good as us giving £ w to the member of the Faculty of Social Sciences?

Please write the amount here:

We will refer to this amount as your equivalence valuation of giving £ w to the member of the Faculty of Social Sciences.

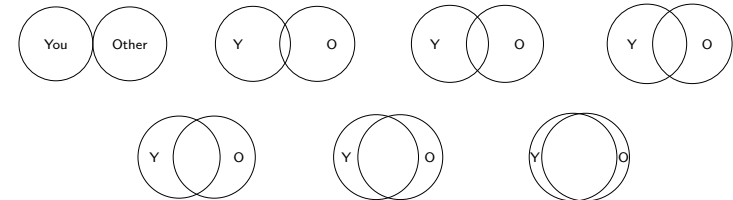
The participant (and hence the Faculty) and the amount of the allocation will change from task to task.

We will never actually give money to you as part of those tasks, but as explained later your answers to the equivalence tasks may affect which participant we will give money to, so please give considered and careful answers.

Circle tasks

For these tasks, we will ask you how you feel toward the participants you have been matched with. You will be asked in this way:

Please consider the member of the Faculty of Engineering. Select the pair of circles that best represents how you feel toward *the member of the Faculty of Engineering*:



Indicate your answer by drawing a line around the pair of circles you select.

Procedure

In a minute, we will ask you to open the envelope labelled 'Part 1'. In it, you will find a booklet containing several of the aforementioned tasks in a random order. On each page, just as at the top of these instructions, you will notice a number: this is your identification number.

As a consequence of your decisions, one of two people with whom you will be matched with—the member of the Faculty of Social Sciences and the member of the Faculty of Engineering—will get paid. We will now explain who and how much. After the experiment and after everybody has left, we will open the envelopes. We will then randomly select one pair of amounts, say $(£y, £z)$, independently for each participant. You would have encountered each of those two amounts twice:

- both of them at the same time in an allocation task, where you had to choose between giving $£y$ to the member of the Faculty of Social Sciences and giving $£z$ to the member of the Faculty of Engineering;
- each of them separately in equivalence tasks, where you had to tell us the amount of money given to you that you think is just as good as giving to the member of the Faculty of Social Sciences or to the member of the Faculty of Engineering.

We will then flip a coin to select between the allocation task and the equivalence task:

- If the allocation task is selected, we will give the money to the person you chose;
- If the equivalence task is selected, we will give the money to the person for which you indicated a higher equivalence valuation.

Let us illustrate this with an example. Imagine two fictitious Faculties: the Faculty of Xenostudies and the Faculty of Patascience. As explained earlier, assume you have been paired with one member from each of those fictitious Faculties. Imagine that the amounts $(£5, £10)$ are selected. During the experiment, you encountered those amounts in the following allocation task:

Option A: We give £5 to the member of the Faculty of Xenostudies
Option B: We give £10 to the member of the Faculty of Patascience

Choose **A** or **B**: A

Suppose you chose **A**, that is, giving £5 to the member of the Faculty of Xenostudies you have been paired with.

You also faced an equivalence task with the member of the Faculty of Xenostudies:

How much money given to you would be just as good as us giving £5 to the member of the Faculty of Xenostudies?

Please write the amount here: 4

We will refer to this amount as your equivalence valuation of giving £5 to the member of the Faculty of Xenostudies.

This example supposed that you stated that the member of the Faculty of Xenostudies having £5 and you getting £4 makes you indifferent. You faced a similar question with the member of the Faculty of Patascience:

How much money given to you would be just as good as us giving £10 to the member of the Faculty of Patascience?

Please write the amount here: 2

We will refer to this amount as your equivalence valuation of giving £10 to the member of the Faculty of Patascience.

Here, imagine that you stated that the member of the Faculty of Patascience having £10 and you getting £2 are just as good.

Finally, we use a coin flip to determine whether it is your response to the allocation task, or your responses to the equivalence tasks that determine the person we will pay on your behalf:

- If the allocation task is selected, we are going to give £5 to the member of the Faculty of Xenostudies because this is what you chose in the allocation task involving the member of the Faculty of Xenostudies and the member of the Faculty of Patascience.
- If the equivalence task is selected, we are going to give £5 to the member of the Faculty of Xenostudies because your equivalence valuation of giving £5 to the member of the Faculty of Xenostudies (£4) is greater than your equivalence valuation of giving £10 to the member of the Faculty of Patascience (£2).

Hence, in this particular example, the money is always given to the member of the Faculty of Xenostudies. This would not have been the case had the answers been different.

At this stage, we will know to whom the money is allocated and we will give the money accordingly. Members of the Faculty of Social Sciences and the Faculty of Engineering will get paid on 13 January 2015 during an experimental session at 10am or at 3pm. You are free to come to the laboratory that day at any of these times to monitor the payment.

We will never tell members of the Faculty of Social Sciences and of the Faculty of Engineering about this experiment. For participants receiving money, the money will appear to come from the experimenter. Participants not receiving money will not know they could have received some money had your choices be different.

Questions on the procedure

We would like to make sure you understand the procedure fully. Please answer the following questions. Once you have finished, raise your hand and an experimenter will come to your desk to verify your answers. There is no identification number on top of those pages so that the experimenters cannot learn your identification number. When s/he comes, please make sure s/he cannot see the other pages. Your answers here have no consequence for the rest of the experiment.

Question 1

Imagine the amounts (£5,£12) are selected after the experiment. The following choices have been made in the relevant allocation tasks and equivalence tasks:

Option A: We give £5 to the member of the Faculty of Social Sciences
Option B: We give £12 to the member of the Faculty of Engineering

Choose **A** or **B**: B

How much money given to you would be just as good as us giving £5 to the member of the Faculty of Social Sciences?

Please write the amount here: 4

We will refer to this amount as your equivalence valuation of giving £5 to the member of the Faculty of Social Sciences.

How much money given to you would be just as good as us giving £12 to the member of the Faculty of Engineering?

Please write the amount here: 14

We will refer to this amount as your equivalence valuation of giving £12 to the member of the Faculty of Engineering.

What happens if the allocation task is selected? Please tick one:

- ☐ We will give £5 to the member of the Faculty of Social Sciences
- ☐ We will give £12 to the member of the Faculty of Engineering

What happens if the equivalence task is selected? Please tick one:

- ☐ We will give £5 to the member of the Faculty of Social Sciences
- ☐ We will give £12 to the member of the Faculty of Engineering

Question 2

Imagine the amounts (£5,£8) are selected after the experiment. The following choices have been made in the relevant allocation tasks and equivalence tasks:

Option A: We give £8 to the member of the Faculty of Engineering
Option B: We give £5 to the member of the Faculty of Social Sciences

Choose **A** or **B**: B

How much money given to you would be just as good as us giving £5 to the member of the Faculty of Social Sciences?

Please write the amount here: 7

We will refer to this amount as your equivalence valuation of giving £5 to the member of the Faculty of Social Sciences.

How much money given to you would be just as good as us giving £8 to the member of the Faculty of Engineering?

Please write the amount here: 3

We will refer to this amount as your equivalence valuation of giving £8 to the member of the Faculty of Engineering.

What happens if the allocation task is selected? Please tick one:

- ☐ We will give £5 to the member of the Faculty of Social Sciences
- ☐ We will give £8 to the member of the Faculty of Engineering

What happens if the equivalence task is selected? Please tick one:

- ☐ We will give £5 to the member of the Faculty of Social Sciences
- ☐ We will give £8 to the member of the Faculty of Engineering

Question 3

Which tasks are relevant if the amounts (£5,£10) are selected? Tick all that apply:

- ☐ How much money given to you would be just as good as us giving £20 to the member of the Faculty of Engineering?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £20 to the member of the Faculty of Engineering.
- ☐ **Option A:** We give £5 to the member of the Faculty of Social Sciences
Option B: We give £8 to the member of the Faculty of Engineering
- Choose **A** or **B**:
- ☐ **Option A:** We give £5 to the member of the Faculty of Social Sciences
Option B: We give £10 to the member of the Faculty of Engineering
- Choose **A** or **B**:
- ☐ How much money given to you would be just as good as us giving £5 to the member of the Faculty of Social Sciences?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £5 to the member of the Faculty of Social Sciences.
- ☐ **Option A:** We give £5 to the member of the Faculty of Social Sciences
Option B: We give £12 to the member of the Faculty of Engineering
- Choose **A** or **B**:
- ☐ How much money given to you would be just as good as us giving £10 to the member of the Faculty of Engineering?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £10 to the member of the Faculty of Engineering.

You can now open the envelope labelled 'Part 1', take out the booklet and start completing the tasks. *Once you have completed a task, please turn the page and do not consider it again.* Once you have completed all the tasks, replace the booklet in the envelope along with the present instructions and close the envelope. Then, please raise your hand. When everybody has finished, we will collect the envelopes and mix them under the supervision of several randomly selected participants.

Notice that each envelope returned will look exactly the same, and since your identification number is attributed randomly we will not be able to tell who filled which booklet.

If you have any question, please raise your hand and an experimenter will come to your table to answer it.

B.2.2 Charity setting

Invitation email

The email below was used to invite members of the Faculty of Social Sciences. For members of the Faculty of Engineering, the only change was “our records indicate you are a member of the Faculty of Engineering.”

Dear **#fname# #lname#**,

You are registered with CeDEx to participate in experiments. We would like to invite you to take part in our upcoming experiment. You are invited to this experiment because our records indicate you are a member of the Faculty of Social Sciences. Please do not sign up to this experiment if this is not the case.

The experiment will take place in the CeDEx computer lab, room C41, Sir Clive Granger Building (University Park). We are planning the following sessions (you can participate in one session only):

#sessionlist#

If you would like to participate, please click on the link below to sign up to the session of your choice. Please note: people that sign up to a session and do not turn up cause us problems; sign up to a session only if you are sure you can attend it, and if you sign up please do attend. We operate a policy of removing participants from our database who sign up but then fail to turn up (without good reason).

#link#

(If the link does not work, copy it and paste it into the address field of your internet browser.)

Please be on time and remember to bring your Student ID to the session.

This experiment is named **#experiment_name#**. Please include “ **#experiment_name#**” in the subject field of any email you send CeDEx regarding this experiment.

Best regards,

Geoffrey Castillo

Instructions

The instructions below were used for members of the Faculty of Engineering. For members of the Faculty of Social Sciences, the only substantial difference was the box on page 1 which asked them to verify they were from the Faculty of Social Sciences. Another minor difference was that their identification numbers started with a ‘Y’.

Instructions

Welcome to the experiment. It is composed of two parts: Part 1 and Part 2. You will receive a payment at the end of the experiment which has been determined by a previous experiment in which you did not participate. The amount you will receive is written on a piece of coloured paper attached to these instructions. Different people in this room have different amounts written on their piece of coloured paper. Please retain it as you will need to give it back to the experimenters at the end of the experiment in order to claim your payment. Also, you will earn more depending on your choices during Part 2. Please remain silent and do not speak with other participants. If you have a question of any kind, please raise your hand at any time and an experimenter will come to your desk.

You have in your possession two envelopes, respectively labelled 'Part 1' and 'Part 2'. They contain the material you will need for this experiment. Please do not open any of the envelopes until instructed to do so by the experimenter.

Before we proceed, we would like you to verify that you are from the Faculty of Engineering. If this is the case, please tick the following checkbox:

☐ I acknowledge I am a member of the Faculty of Engineering.

If this is not the case, please raise your hand and wait for an experimenter to come to your desk.

We have a lot of procedures in place throughout the experiment designed to ensure your anonymity. The first one is the use of an identification number. This is the number printed at the top of this page. Each of the experimental packages that you saw outside the room had a different identification number. In effect, one of the identification numbers has been randomly attributed to you as you randomly selected one of the experimental packages. Your decisions are linked to this identification number, not to your identity. We are trying our best not to link your decision to your identity, so please play your part in not allowing anyone—including the experimenters—to see this identification number.

We will now present Part 1 of the experiment in detail.

Part 1

In this part of the experiment, we will give money to one of two charities depending on your choices. Hence, *the money donated is not your money* and nothing is taken from you.

The experimental material for Part 1 of the experiment is composed of the present instructions and the envelope labelled 'Part 1'. Do not open the envelope until instructed to do so.

We will start by describing the tasks.

Tasks

There will be four types of tasks, which we call **allocation tasks**, **equivalence tasks**, **circle tasks** and **familiarity tasks**.

Allocation tasks

Allocation tasks ask you to choose between two alternatives. Here is an example:

Option A: We give £5 to *Cancer Research UK*

Option B: We give £6 to *The Salvation Army*

Choose **A** or **B**:

You will choose one of the two options by writing 'A' or 'B'. There will be a range of such tasks involving different money amounts.

Equivalence tasks

In equivalence tasks, we propose an allocation of a specific amount to either Cancer Research UK or The Salvation Army. We then ask you to specify how much money we would have to *give to you* instead so that you would think that amount of money was just as good as the proposed allocation. Here is an example:

How much money *given to you* would be just as good as us giving £5 to *Cancer Research UK*?

Please write the amount here:

We will refer to this amount as your equivalence valuation of giving £5 to Cancer Research UK.

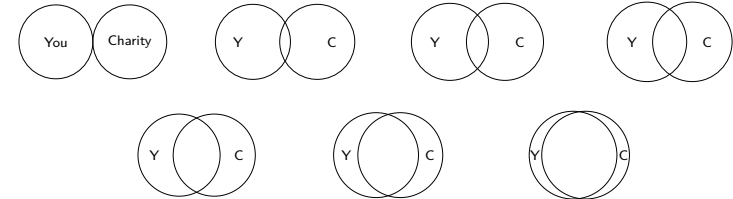
The charity and the amount of the allocation will change from task to task.

We will never actually give money to you as part of those tasks, but as explained later your answers to the equivalence tasks may affect which charity we will give money to, so please give considered and careful answers.

Circle tasks

For these tasks, we will ask you how you feel toward a charity. You will be asked in this way:

Please consider Cancer Research UK. Select the pair of circles that best represents how you feel toward *Cancer Research UK*:



Indicate your answer by drawing a line around the pair of circles you select.

Familiarity tasks

For these, we ask you how familiar you are with the charities. Here is an example:

Indicate how familiar you are with *Cancer Research UK* by ticking one of the following options:

- ☐ I have never heard of it
- ☐ I have only heard the name
- ☐ I know the name but I have only a vague idea of what it does
- ☐ I know the name and I have a good idea of what it does

Procedure

In a minute, we will ask you to open the envelope labelled 'Part 1'. In it, you will find a booklet containing several of the aforementioned tasks in a random order. On each page, just as at the top of these instructions, you will notice a number: this is your identification number.

As a consequence of your decisions, we will donate some money to one of the two charities—either Cancer Research UK or The Salvation Army. We will now explain which one and how much. After the experiment and after everybody has left, we will open the envelopes. We will then randomly select one pair of amounts, say $(£y, £z)$, independently for each participant. You would have encountered each of those two amounts twice:

- both of them at the same time in an allocation task, where you had to choose between giving $£y$ to Cancer Research UK and giving $£z$ to The Salvation Army;
- each of them separately in equivalence tasks, where you had to tell us the amount of money given to you that you think is just as good as giving to Cancer Research UK or to The Salvation Army.

We will then flip a coin to select between the allocation task and the equivalence task:

- If the allocation task is selected, we will give the money to the charity you chose;
- If the equivalence task is selected, we will give the money to the charity for which you indicated a higher equivalence valuation.

Let us illustrate this with an example. Imagine two fictitious charities: Nolfolck and UCAR. Imagine that the amounts $(£5, £10)$ are selected. During the experiment, you encountered those amounts in the following allocation task:

Option A: We give £5 to Nolfolck
Option B: We give £10 to UCAR

Choose **A** or **B**: *A*

Suppose you chose **A**, that is, giving £5 to Nolfolck.

You also faced an equivalence task with Nolfolck:

How much money given to you would be just as good as us giving £5 to Nolfolck?

Please write the amount here: *4*

We will refer to this amount as your equivalence valuation of giving £5 to Nolfolck.

This example supposed that you stated that Nolfolck having £5 and you getting £4 makes you indifferent. You faced a similar question with UCAR:

How much money given to you would be just as good as us giving £10 to UCAR?

Please write the amount here: *2*

We will refer to this amount as your equivalence valuation of giving £10 to UCAR.

Here, imagine that you stated that UCAR having £10 and you getting £2 are just as good.

Finally, we use a coin flip to determine whether it is your response to the allocation task, or your responses to the equivalence tasks that determine the charity we will donate the money on your behalf:

- If the allocation task is selected, we are going to give £5 to Nolfolck because this is what you chose in the allocation task involving Nolfolck and UCAR.
- If the equivalence task is selected, we are going to give £5 to Nolfolck because your equivalence valuation of giving £5 to Nolfolck (£4) is greater than your equivalence valuation of giving £10 to UCAR (£2).

Hence, in this particular example, the money is always given to Nolfolck. This would not have been the case had the answers been different.

At this stage, we will know to which charity each participant in this experiment allocated money. We will then calculate the total allocations to the two charities and, following this session, we will arrange two separate transfers for the calculated amounts due to Cancer Research UK and The Salvation Army. The payments will be made by a member of the School of Economics staff via the respective websites of the charities. We will make payment in the name of CeDEX. Once the payment is made, we will send you a copy of the receipts from the charities—one for the donation to Cancer Research UK, one for the donation to The Salvation Army—via email.

We will never tell the charities about this experiment. For charities receiving money, the money will appear to come from the experimenter. Charities not receiving money will not know they could have received some money had your choices been different.

Questions on the procedure

We would like to make sure you understand the procedure fully. Please answer the following questions. Once you have finished, raise your hand and an experimenter will come to your desk to verify your answers. There is no identification number on top of those pages so that the experimenter cannot learn your identification number. When s/he comes, please make sure s/he cannot see the other pages. Your answers here have no consequence for the rest of the experiment.

Question 1

Imagine the amounts (£5,£12) are selected after the experiment. The following choices have been made in the relevant allocation tasks and equivalence tasks:

Option A: We give £5 to the member of Cancer Research UK
Option B: We give £12 to the member of The Salvation Army

Choose **A** or **B**: B

How much money given to you would be just as good as us giving £5 to the member of Cancer Research UK?

Please write the amount here: 4

We will refer to this amount as your equivalence valuation of giving £5 to the member of Cancer Research UK.

How much money given to you would be just as good as us giving £12 to the member of The Salvation Army?

Please write the amount here: 14

We will refer to this amount as your equivalence valuation of giving £12 to the member of The Salvation Army.

What happens if the allocation task is selected? Please tick one:

- ☐ We will give £5 to the member of Cancer Research UK
- ☐ We will give £12 to the member of The Salvation Army

What happens if the equivalence task is selected? Please tick one:

- ☐ We will give £5 to the member of Cancer Research UK
- ☐ We will give £12 to the member of The Salvation Army

Question 2

Imagine the amounts (£5,£8) are selected after the experiment. The following choices have been made in the relevant allocation tasks and equivalence tasks:

Option A: We give £8 to the member of The Salvation Army
Option B: We give £5 to the member of Cancer Research UK

Choose **A** or **B**: B

How much money given to you would be just as good as us giving £5 to the member of Cancer Research UK?

Please write the amount here: 7

We will refer to this amount as your equivalence valuation of giving £5 to the member of Cancer Research UK.

How much money given to you would be just as good as us giving £8 to the member of The Salvation Army?

Please write the amount here: 3

We will refer to this amount as your equivalence valuation of giving £8 to the member of The Salvation Army.

What happens if the allocation task is selected? Please tick one:

- ☐ We will give £5 to the member of Cancer Research UK
- ☐ We will give £8 to the member of The Salvation Army

What happens if the equivalence task is selected? Please tick one:

- ☐ We will give £5 to the member of Cancer Research UK
- ☐ We will give £8 to the member of The Salvation Army

Question 3

Which tasks are relevant if the amounts (£5,£10) are selected? Tick all that apply:

- ☐ How much money given to you would be just as good as us giving £20 to the member of The Salvation Army?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £20 to the member of The Salvation Army.
- ☐ **Option A:** We give £5 to the member of Cancer Research UK
Option B: We give £8 to the member of The Salvation Army
- Choose **A** or **B**:
- ☐ **Option A:** We give £5 to the member of Cancer Research UK
Option B: We give £10 to the member of The Salvation Army
- Choose **A** or **B**:
- ☐ How much money given to you would be just as good as us giving £5 to the member of Cancer Research UK?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £5 to the member of Cancer Research UK.
- ☐ **Option A:** We give £5 to the member of Cancer Research UK
Option B: We give £12 to the member of The Salvation Army
- Choose **A** or **B**:
- ☐ How much money given to you would be just as good as us giving £10 to the member of The Salvation Army?
- Please write the amount here:
- We will refer to this amount as your equivalence valuation of giving £10 to the member of The Salvation Army.

You can now open the envelope labelled 'Part 1', take out the booklet and start completing the tasks. *Once you have completed a task, please turn the page and do not consider it again.* Once you have completed all the tasks, replace the booklet in the envelope along with the present instructions and close the envelope. Then, please raise your hand. When everybody has finished, we will collect the envelopes and mix them under the supervision of several randomly selected participants.

Notice that each envelope returned will look exactly the same, and since your identification number is attributed randomly we will not be able to tell who filled which booklet.

If you have any question, please raise your hand and an experimenter will come to your table to answer it.

Table B.1: Frequencies of the patterns by pairs of allocations and by setting.

$(x_P, x_§)$	(£5, £6)	(£5, £7)	(£5, £8)	(£5, £9)	(£5, £10)	<i>Total</i>
<i>Faculty</i>						
Consistent for P-a	11	9	4	3	1	28
Consistent for \$-a	22	23	26	25	34	130
Standard preference reversal	18	19	20	25	16	98
Counter preference reversal	4	4	5	2	4	19
<i>Total</i>	55	55	55	55	55	275
<i>Charity</i>						
Consistent for P-a	13	8	7	5	5	38
Consistent for \$-a	20	21	26	27	27	121
Standard preference reversal	3	6	1	2	3	15
Counter preference reversal	0	1	2	2	1	6
<i>Total</i>	36	36	36	36	36	180

controlling for charity knowledge

B.3 Preference reversals

The main text only considered cases in which the recipient of the P-allocation received a higher IOS or IIS rating than the recipient of the \$-allocation. Table B.1 and Figure B.1 do the same analysis without this requirement.

B.4 Mixed logit model

In the main text, I have used a conditional logit model to analyse choice and valuation data. The conditional logit model makes two restrictive assumptions: the independence of irrelevant alternatives, and that all subjects have the same preferences. In this section, I relax these two assumptions by using a mixed logit model.

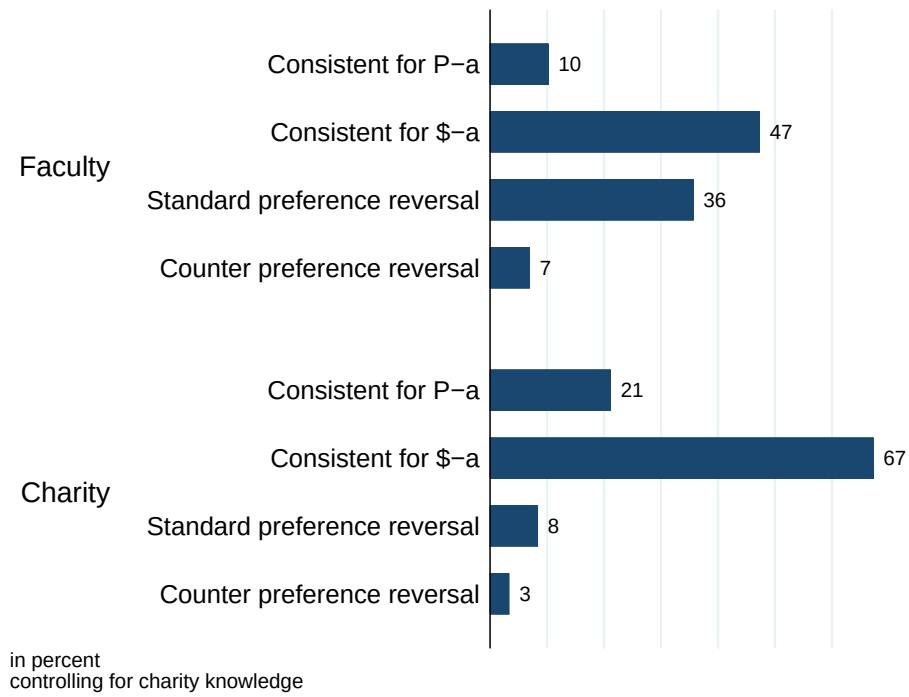


Figure B.1: The preference reversal phenomenon exists only in the Faculty setting.

B.4.1 Setup

A subject n faces pairs of allocations labelled by t . In each pair, there is one P- and one \$-allocation, labelled by i . An allocation i in the pair t is characterised by two attributes: the amount of money $\mathcal{L}_{ti}$ and the IOS or IIS measure I_{ti} . The utility derived from an allocation in a pair is

$$\tilde{U}_{nti} = \beta_n^{\mathcal{L}} \mathcal{L}_{ti} + \beta_n^I I_{ti} + \epsilon_{nti} \quad (\text{B.1})$$

in which ϵ_{nti} is independently and identically distributed extreme value over subjects, pairs and allocations. I assume that the parameters $(\beta_n^{\mathcal{L}}, \beta_n^I)$ are distributed the density function $f(\beta|\mu, \sigma)$ which allows them to vary over subjects but to be constant over pairs for a given subject.

Conditional on a given β_n , the probability that a subject n chooses the allocation i in the pair t is the choice probability in the conditional logit model

$$L_{nti}(\beta_n) = \frac{e^{\beta_n^{\mathcal{L}} \mathcal{L}_{ti} + \beta_n^I I_{ti}}}{\sum_i e^{\beta_n^{\mathcal{L}} \mathcal{L}_{ti} + \beta_n^I I_{ti}}},$$

and the probability this subject makes a sequence of choices $\{i_1, \dots, i_5\}$ is

$$L_n(\beta_n) = \prod_{t=1}^5 L_{nti_t}(\beta_n).$$

We do not know β_n since we assume it to be random, so we are left with the unconditional choice probability

$$P_n(\mu, \sigma) = \int L_n(\beta_n) f(\beta|\mu, \sigma) d\beta \quad (\text{B.2})$$

which is the mixed logit probability.

The integral (B.2) typically does not have a closed form solution and should be approximated through simulation with the following procedure (Train, 2009). For given values of (μ, σ) , a β_n is drawn from $f(\beta|\mu, \sigma)$. Call this draw β_n^r , the r referring to the r^{th} draw. Then, compute $L_{nti}(\beta_n^r)$ and

$L_n(\beta_n^r)$. Repeat R times and average the results to form the simulated probability

$$\tilde{P}_n(\theta) = \frac{1}{R} \sum_{r=1}^R L_n(\beta_n^r).$$

The simulated log-likelihood is given by

$$\text{SLL} = \sum_{n=1}^N \ln \tilde{P}_n(\theta)$$

and the maximum simulated likelihood estimator is the value of (μ, σ) that maximises SLL. The implementation was done in STATA using the command `mixlogit` written by Hole (2007).

B.4.2 Specification tests

McFadden and Train (2000) provide a Lagrange Multiplier test to assess whether or not parameters need to be assumed random. This test concluded that both parameters needed to be assumed random in the Charity setting; and only the amount parameter in the Faculty setting. The next question is to select the distribution for the parameters.

Hensher and Greene (2003) describe a method to recover non-parametrically the empirical distribution of the parameters. In essence, the method amounts to estimate $N + 1$ models where N is the total number of subjects intended to be included in the final regression. In each model, one subject is left out of the regression. The additional regression is a model with all subjects included. By looking at the difference between the parameter estimate in the full model and the parameter estimate of the model leaving out one subject, one can study the contribution (‘incremental marginal utility’ in Hensher and Greene’s terms) of this subject to the full sample mean parameter estimate. Using a kernel density plot, one can then study the parameter distribution in a given sample. Figures B.2 and B.3 report these kernel density plot for each parameter and each task, in the Faculty and the Charity setting. These

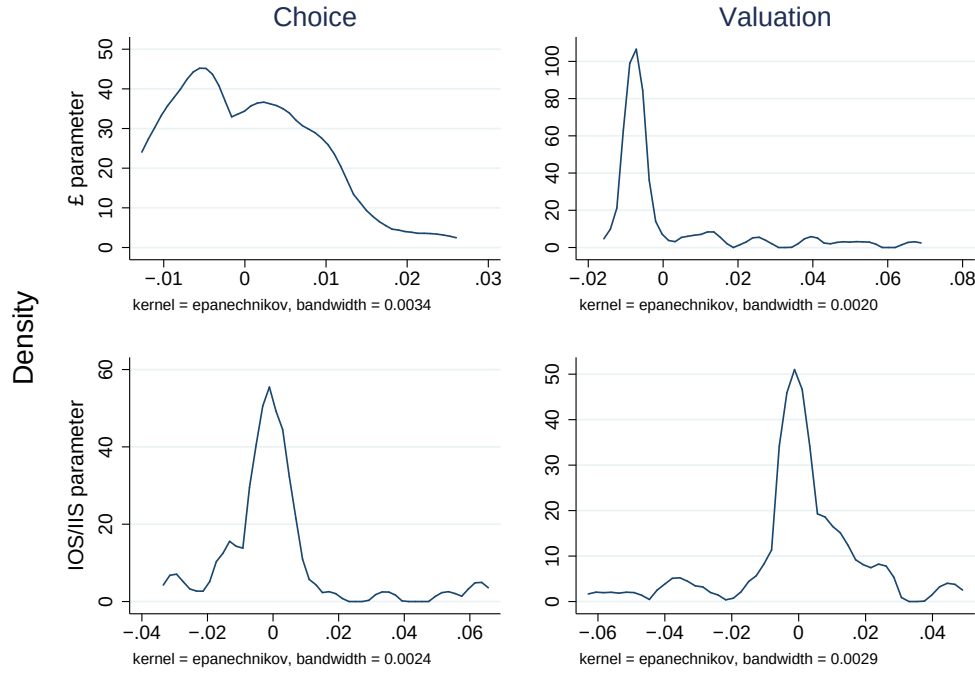


Figure B.2: Empirical distribution of the two parameters in the Faculty setting.

plots reveal distributions with supports spanning both positive and negative values which excludes the log-normal distribution. They also reveal long tails and skewed distributions which might be a problem for the estimation. However, Figure B.4 show that these tails are mostly caused by a small number of subject with exceptionally large empirical parameters. With these caveats in mind, I decided to use normal distributions for both parameters.

I estimated the model a first time. It gave conclusive answers except in the Charity setting with valuation data where I obtained large standard errors. Further analysis showed that a small number of subjects had large residuals. Upon further inspection, the behaviour of these subjects proved to be peculiar. These subjects either did not complete all tasks or switched preference between each pair. We decided to exclude them from the final estimation.

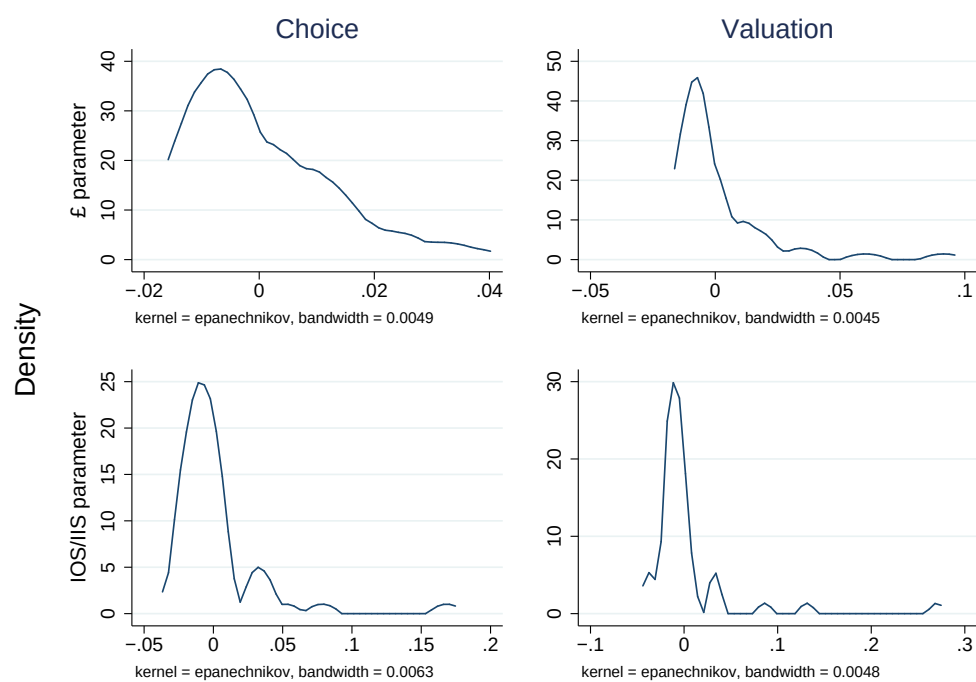


Figure B.3: Empirical distribution of the two parameters in the Charity setting.

B.4.3 Estimation results

Table B.2 reports the estimation results. In the Faculty setting, the mean of the IOS or IIS parameter β_n^I is positive and significant in choice but not valuation: subjects are more likely to select an allocation benefiting a closer (higher IOS or IIS measure) individual or charity when they choose but not when they report their valuations. Conversely, the mean of the amount parameter $\beta_n^{\mathcal{L}}$ is positive and significant in valuation but not in choice. In the Charity setting, the two parameters are positive and significant in choice and valuation so subjects always take into account both attributes.

B.5 Reliability of the IOS and IIS measures

Table B.3 compares the values I obtained with the values observed in the literature. The values are coherent with previous studies and in line with prior expectations. For example, higher or lower IOS values in the experiment would be suspect since subjects in our Faculty setting considered neither a good friend nor someone with whom they did not share anything. Looking across studies, we see that the values obtained in different studies are compatible with one another, despite having been administered on different populations and in different contexts.

Table B.2: Results from a mixed logit model with robust standard errors.

$$\tilde{U}_{nti} = \beta_n^{\mathcal{L}} \mathcal{L}_{ti} + \beta_n^I I_{ti} + \epsilon_{nti}$$

	Faculty		Charity [†]	
	Choice <i>Coef. (SE)</i>	Valuation <i>Coef. (SE)</i>	Choice <i>Coef. (SE)</i>	Valuation [‡] <i>Coef. (SE)</i>
Mean				
£	0.214 (0.123)	2.143*** (0.639)	0.889** (0.317)	2.673** (0.854)
IOS/IIS	0.413* (0.166)	−0.092 (0.287)	1.936* (0.801)	7.216* (3.230)
SD				
£	0.682*** (0.161)	1.844** (0.623)	1.108** (0.408)	−0.124 (0.119)
IOS/IIS	— —	— —	2.225** (0.808)	9.611* (4.872)
Observations	550	510	520	420
Log-likelihood	−159.707	−70.488	−109.816	−31.656
Wald χ^2	7.722	11.313	8.165	9.829
Prob > χ^2	0.021	0.003	0.017	0.007
BIC	338.343	159.679	244.647	87.473
Likelihood ratio index	0.162	0.601	0.391	0.783

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Number of Halton draws used for simulation: 500

Wald χ^2 tests the joint significance of the standard deviations

[†]subjects not knowing the charities included

[‡]subjects Z05, Z13 and Z17 excluded

Table B.3: IOS and IIS measures obtained in the present and in other studies.

Study	Target object	Mean*
<i>IOS</i>		
Cialdini et al. (1997)	Near stranger	1.52–2.40
Gächter et al. (2015)	Acquaintance	2.30
Cialdini et al. (1997)	Acquaintance	3.02–3.56
Present study	Member Faculty of Engineering	3.05
Present study	Member Faculty of Social Sciences	3.35
Waugh and Fredrickson (2006)	New flatmate	3.64
Gächter et al. (2015)	Friend	3.70
Waugh and Fredrickson (2006)	Flatmate after 2 months	3.89
Agnew et al. (1998)	Partner/best friend	4.03–4.72
Cialdini et al. (1997)	Good friend	4.43–5.24
Cialdini et al. (1997)	Close family member	4.57–5.66
Aron et al. (1992)	Closest person	4.74
Gächter et al. (2015)	Closest person	5.30
<i>IIS</i>		
Present study	The Salvation Army	2.75
Present study	Cancer Research UK	3.25
Schubert and Otten (2002)	National outgroup	3.50
Gomez et al. (2011)	National outgroup	4.20–5.20
Tropp and Wright (2001)	Ethnic ingroup	4.52–5.63
Tropp and Wright (2001)	Gender ingroup	4.90
Schubert and Otten (2002)	National ingroup	5.13

*ranges are reported when the same target object is used in different experiments within the same paper.

Appendix to Chapter 3

C

C.1 Pictures



(a) Entering the laboratory.



(b) Boxes containing the envelopes.



(c) Inside a box.



(d) A subject's desk.

C.2 Instructions

Instructions

Welcome to the experiment. Please switch off your electronic devices and remain silent. If you have a question at any time, raise your hand and an experimenter will come to your desk to answer it.

* * *

In this experiment, you will face options that give you chances to win amounts of money. An option is for example a 20%-chance of winning £35.

To represent the chances of winning, we will refer to the dice placed on your desk, which you are welcome to examine as much as you want throughout the experiment. One die is used for the tens and the other for the units. Throwing the dice together and adding the results yields a number from 1 to 100. For example, the throw below is 31:



The next one is 8:



100 is obtained by getting zeros on both dice. Each ten and each unit is equally likely, so *each number from 1 to 100 is also equally likely.*

In terms of the dice, the 20%-chance of winning £35 is equivalent to £35 for numbers from 1 to 20, and £0 for numbers from 21 to 100. We will represent it as follows:

1	20	21	100
£35	£0		

This means that, if the dice throw yields a number from 1 to 20, you will receive £35. If it yields a number from 21 to 100, you will receive £0.

* * *

All tasks in this experiment will ask you to select one from a set of two or three such options. The options in these tasks are always gambles which will feature different chances of winning various amounts of money. You will record your selected option in each of these tasks in decision booklets, which we will distribute soon. There will be a different task of this form on each page.

You will play one of the gambles that you select for real at the end of the experiment, meaning that you might win some money in this real task. The task that is real for you has already been selected in the following way: When you entered the room, you picked one from a set of envelopes. Each envelope contains a piece of paper describing one of the tasks that you will face in your booklet. Any one of the tasks that you face could be for real, but you will not know which one is for real until the end of the experiment.

At the end of the experiment, an experimenter will come to your desk and open your envelope. The piece of paper in the envelope will show the task that will be real for you. The experimenter will then look in your decision booklet to see which option you picked in this task. That option will be a gamble which will specify an amount of money that you can win depending on the throw of the dice. You will then roll the dice to see whether you earn money from the real task or not. If you win, you will be paid in cash the amount specified in your chosen option.

So, as you respond to the tasks remember that for each task, the option that you pick could turn out to be the one that you play for real at the end of the experiment. Because of this, we suggest that you treat each task as if it is for real and as if it is the only task you face since at the end of the experiment you will only face one task for real (i.e. the one contained in the envelope you now have).

Let us illustrate this with an example.

Imagine that one of the pages of the decision booklet is as follows: (The presentation will be the same, but the options will be different.)

Page A

In one of the envelopes, the options are:

	1	60	61	100
P	£12		£0	

	1	40	41	100
Q	£25		£0	

If these options are the ones in my envelope, give me option: (write P or Q in the box)

P

- writing **P** means that I will receive £12 if the dice throw yields a number from 1 to 60, and £0 otherwise;
- writing **Q** means that I will receive £25 if the dice throw yields a number from 1 to 40, and £0 otherwise.

This example assumes that you chose option P.

Then, imagine that another page of the decision booklet is:

Page B

In one of the envelopes, the options are:

	1	30	31	100
P	£20		£0	

	1	50	51	100
Q	£10		£0	

	1	20	21	100
R	£40		£0	

If these options are the ones in my envelope, give me option: (write P, Q or R in the box)

R

- writing **P** means that I will receive £20 if the dice throw yields a number from 1 to 30, and £0 otherwise;
- writing **Q** means that I will receive £10 if the dice throw yields a number from 1 to 50, and £0 otherwise;
- writing **R** means that I will receive £40 if the dice throw yields a number from 1 to 20, and £0 otherwise.

Here, we assume that you chose option R.

At the end of the experiment, the experimenter comes to your desk and opens your envelope. Suppose that your envelope contains:

P	1	60	61	100
	£12		£0	

Q	1	40	41	100
	£25		£0	

The experimenter will look for these options in your decision booklet. They were in Page A above and we assumed that you chose option P. The experimenter will then throw the dice. In accordance with what is written in the decision booklet, you would get £12 if the throw yields a number from 1 to 60, and £0 if it yields a number from 61 to 100.

Questions

We want to make sure you understand the procedure fully, so we have designed two questions to test your understanding. These questions have no bearing on the rest of the experiment. Please answer them and raise your hand when you have finished; an experimenter will come to verify your responses.

Question 1

Imagine that the options in your envelope are:

P	1	85	86	100
	£8			£0

Q	1	80	81	100
	£13			£0

These two options are the ones on the following page of the decision booklet:

In one of the envelopes, the options are:

	1	85	86	100
P	£8			£0

	1	80	81	100
Q	£13			£0

If these options are the ones in my envelope, give me option: (write P or Q in the box)

- writing **P** means that I will receive £8 if the dice throw yields a number from 1 to 85, and £0 otherwise;
- writing **Q** means that I will receive £13 if the dice throw yields a number from 1 to 80, and £0 otherwise.

What happens if:

- you write **P** and the dice throw yields **81**?
- you write **P** and the dice throw yields **91**?
- you write **Q** and the dice throw yields **81**?
- you write **Q** and the dice throw yields **10**?

Question 2

Suppose that you encounter the next two pages in your decision booklet and make the following choices:

Page A

In one of the envelopes, the options are:

	1		70	71		100
P	£14			£0		

	1		20	21		100
Q	£35			£0		

If these options are the ones in my envelope, give me option: (write P or Q in the box)

Q

- writing **P** means that I will receive £14 if the dice throw yields a number from 1 to 70, and £0 otherwise;
- writing **Q** means that I will receive £35 if the dice throw yields a number from 1 to 20, and £0 otherwise.

Page B

In one of the envelopes, the options are:

	1		20	21		100
P	£50			£0		

	1		50	51		100
Q	£12			£0		

	1		30	31		100
R	£23			£0		

If these options are the ones in my envelope, give me option: (write P, Q or R in the box)

R

- writing **P** means that I will receive £50 if the dice throw yields a number from 1 to 20, and £0 otherwise;
- writing **Q** means that I will receive £12 if the dice throw yields a number from 1 to 50, and £0 otherwise;
- writing **R** means that I will receive £23 if the dice throw yields a number from 1 to 30, and £0 otherwise.

If the options in your envelope are:

P	1	20	21	100
	£50		£0	

Q	1	50	51	100
	£12		£0	

R	1	30	31	100
	£23		£0	

Which option is going to be played for real?

If the dice throw yields 24, what happens?
.....

We are now ready to distribute the first decision booklet. You can start completing it as soon as you get it. When you have finished, raise your hand; we will collect your booklet and give you a second one for you to complete.

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This thesis was typeset using the L^AT_EX typesetting system originally developed by Leslie Lamport, based on T_EX created by Donald Knuth.

*The body is set with Donald Knuth's Computer Modern family in 12pt.
The title page uses Pagella from the T_EX Gyre family.*

I thank the community at tex.stackexchange.com for the technical help.