‘Right on Time’:
On the relationships between moral concepts and temporal discounting.

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Certificate of Authorship

I hereby declare that this submission is my own work and to the best of my knowledge and belief, understand that it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Charles Sturt University or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by colleagues with whom I have worked at Charles Sturt University or elsewhere during my candidature is fully acknowledged.

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Signed ____________________________________________

on March 25th, 2013.
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Abstract

Philosophical traditions place self-restraint at the centre of virtue ethics, while recent theoretical and empirical work in moral psychology suggests that self-control is “the master virtue” (Baumeister & Exline, 1999, p. 1165). However, the connections between moral attitudes and impulsivity have rarely been addressed explicitly; this thesis investigated these relationships. Chapter 1 presented theoretical and empirical rationales for our investigations, and introduced our measures of moral attitudes and impulsivity: Moral Foundations Theory and Temporal Discounting, respectively. Chapter 3 demonstrated the test-retest stability of a temporal discounting measure used in much of the thesis.

Chapters 2 and 4 investigated relationships between impulsivity and concerns for the five moral themes elucidated by Moral Foundations theory. Positive relationships between the Moral Foundations and temporal discounting rates were detected, but only where participants were required to bid on delayed monies with their own funds (Chapter Four). Moreover, correlations were mediated by education for the ‘Binding’ moral foundations (Loyalty, Authority & Purity) but not the Individualising foundations. We submit that loss aversion played a role in these results, which is congruent with moral theories that argue for the primacy of emotional processes in moral cognition.

Chapters 5, 6 and 7 investigated the effects of external cues (i.e. supraliminal primes) on impulsivity. Contrary to expectations, primes related to ‘Fairness’ produced within-subjects increases in temporal discounting rates (Chapter Five). However, an attempted replication of the effect, also employing Shariff and Norenzayan’s (2007) religion priming task, detected no priming effects on discounting rates (Chapter 6). In Chapter 7, participants completed the primes used in Chapters 5 and 6 in a between
subjects design. The Fairness prime used in Chapter 5 took significantly longer to complete than the Fairness prime used in Chapter 6, or the Neutral primes used in either study. We argue that the between conditions differences in task difficulty (inferred by latency) were idiosyncratic rather than caused by the moral content of the primes, accounting for the results in Chapter 5. We suggest differences in task difficulty are a potential confound which priming studies should rule out.

This thesis indicates that moral cognitions do not suppress impulsivity. It appears that priming moral (and religious) concepts do not influence temporal discounting rates, at least not in a domain general sense. In light of the recent social priming literature—reviewed in Chapters 6 and 8—it is more likely that moral primes increase the subjective value of social reputation, increasing motivation toward other-regarding behaviours. As such, in our studies—which eliminated opportunities for socially desirable responding—the primes had no effect on subsequent decisions.

The primary contributions of the thesis include new data on the stability of the second price (Vickrey) auction method of estimating temporal discounting rates, some evidence for the (positive) association between impulsivity and moral concerns as well as the mediating role of education. In addition, the thesis ruled out domain general influences of moral and religious cues on temporal discounting rates, and described a potential confound in the supraliminal priming of social behaviour.
Chapter 1

Morality, Impulsivity and Temporal Discounting
Morality, Impulsivity and Temporal Discounting

The notion that morality and self-control are positively associated is ubiquitous in the philosophical and the psychological literature. Temperance (i.e. the restraint of impulsivity) is a key plank in the ethics of virtue literature (Hursthouse, 1999). Ancient Greek philosophical traditions regarded the inability to curb one’s impulses as a moral failing; named ‘akrasia’ (Korsgaard, 1986; Kraut, 2010). Baumeister and Exline (1999) go as far as to claim moral conduct may be impossible without self-control. Referring to it as ‘the moral muscle’ (p. 1165), they argue that ‘it is fair to consider self-control the master virtue’ (p. 1175). Indeed, the word ‘virtuous’ has entered the vernacular as an adjective for one who displays the ability to delay gratification and control one’s impulses in the service of a longer-term goal.

A few studies have examined the relationship between impulsivity and moral behaviours such as cooperation and pro-social or ‘altruistic’ punishment, finding that impulsivity may be positively or negatively associated with pro-sociality, depending on the type of pro-social action involved. For example, less impulsive individuals tend to be more cooperative (Curry, Price, & Price, 2008; Yi, Johnson, & Bickel, 2005), while more impulsive people tend to (altruistically) punish unfairness more readily (Crockett, Clark, Liebermann, Tabibnia, & Robbins, 2010). However, it is not clear from these studies what kinds of moral attitudes—if any—are involved. Causal directions are not clear either. Does patience promote moral behaviour, while moral attitudes produce patience? In Chapter 2 we suggest that patience may lead to stronger moral attitudes. Nevertheless, Haidt and Kesebir (2010) assume morality’s causal function, defining morality as:

“interlocking sets of … evolved psychological mechanisms that work together to suppress or regulate selfishness and make cooperative social life possible.” (p. 800, our emphasis).
The above definition assumes—reasonably—that social life confers adaptive benefits and reproductive advantages when compared to a solitary existence. If morality contributes to making social life possible, it is adaptive. Thus morality’s ultimate function is to suppress selfish impulses. This is still a matter of considerable debate, and although selfless behaviour in economic games has been demonstrated empirically, it may not be universal (Henrich, Heine & Norenzayan, 2010). Nevertheless, it raises the question of how the cognitive mechanisms that encourage selfless behaviours operate. If moral concepts suppress selfishness, does this occur via the reduction of impulsivity? Moreover, if moral concepts suppress selfishness and/or impulsivity, will any concept we normally define as ‘moral’ have this effect, and if not, should the term ‘moral’ be restricted to only those concepts that do restrict impulsivity? The present thesis does not purport to answer all of these questions, but aims to begin a program of research that might contribute a more nuanced view of the relationship between different ‘moral’ concepts and impulsivity.

Observations that moral behaviours (e.g. cooperation) appear to be more frequent in those with lower impulsivity rates (Curry et al., 2008; Yi, Buchhalter, Gatchalian, & Bickel, 2007; Yi et al., 2005) are interesting and important contributions. However, if these findings are to be used to influence behaviour, a better understanding of the cognitive representations and beliefs that underpin those relationships may be beneficial.

In light of the foregoing, it is clear that the time is ripe for a more focused series of investigations into the relationships between self-control and moral attitudes. Specifically, this thesis focused on two assumptions. The first—and oldest—assumption was that impulsivity has an inverse association with moral virtue (Korsgaard, 1986; Kraut, 2010). To this end, Chapters 2 and 4 concern correlational
relationships between impulsivity and a contemporary taxon of moral attitudes, accompanied by a consideration of potential mediators. The latter sections address a hitherto untested implication that has been building in the religious, moral (Haidt & Kesebir, 2010; McCullough & Willoughby, 2009; Preston, Ritter & Hernandez, 2010; Rounding, Lee, Jacobson & Ji, 2012) and environmental psychology literatures (Böhm & Pfister, 2005; Gattig & Hendrickx, 2007). Specifically, the assumption that moral concepts—and religious ones via the activation of moral attitudes (Randolph-Seng & Nielsen, 2008)—can suppress or even suspend impatience. This assumption was investigated in Chapters 5, 6 and 7.

Which Morality?

To discuss secular morality as if it were a single phenomenon is—in light of contemporary understanding—tantamount to a cognitive psychologist referring to ‘memory’. Violations of social rules that fall under the term ‘morality’ can elicit very different emotions; violations of cleanliness rules tend to elicit disgust, cheating tends to elicit contempt, while intentionally harming others may elicit anger or rage (Haidt, 2001; Haidt & Joseph, 2004; Haidt & Kesebir, 2008). Sinnott-Armstrong (2007) argues that there is no parameter on which morality is unified. So it is not surprising that there has been considerable—and fruitful—debate on what a comprehensive moral taxon should look like. For example, is a distinction between moral rules and social conventions justified (Haidt & Kesebir, 2008; Sinnott-Armstrong, 2007) or should both simply come under the umbrella term of ‘values’ (Fiske, 1991; Rai & Fiske, 2011; Schwartz & Bilsky, 1987)? Moreover, diverse theorists have very different ideas about what constitutes a moral concern. While Graham, Haidt and Nosek (2011) have argued that the majority of social scientists regard individuals’ autonomy and rights as the locus of moral concern, Fiske (1991) includes only those
goals that contribute to ‘functions for the collectivity’ under the term ‘moral standards’ (p. 698).

Schwartz and Bilsky (1987) described a universal set of human values that included, but was not restricted to, those generally regarded as moral values (e.g. equity, loyalty). Three features of their model mark it out as a precursor to the Moral Foundations Theory (Graham et al., 2011) that featured significantly in the present thesis. First, their taxonomy of human values clearly distinguished between those that centred on concerns for individuals (i.e. maturity, self-direction, enjoyment & achievement) versus the ‘collectivist’ values (restrictive conformity, prosociality & security, p. 554). Second, Schwartz and Bilsky (1987) claimed their value structure was universal in terms of the value categories they described; cross cultural variability was described and accounted for as differences in the relative emphasis placed on these values by the culture in question. Finally, their model grouped categories of values so as to illustrate the extent to which they are compatible. For example, individual values like ‘self-direction’ are grouped with goals that can be pursued concurrently (e.g. ‘achievement’), and positioned spatially opposite those goals that would conflict with it (e.g. conformity) and as such may call for what Aristotle referred to as a ‘golden mean’ (Korsgaard, 1986; Kraut, 2010); a healthy tension between opposite poles.

Fiske’s (1991) description of the elements of social interaction also claims to encompass all human values as codified in four categories of human social exchange. ‘Communal Sharing’ describes relations that are predicated on the notion of equal rights of access to the resources controlled by the group. If the group has it, it is yours to use. Reciprocally, anything in your possession equally belongs to any other member of your group. ‘Authority Ranking’ refers to relations that order access to and control of resources according to a cultural system (e.g. vocation, title, age). ‘Equality
Matching’ preserves the order of exchange by monitoring reciprocity; namely, who owes what to whom. For example, one may not keep track of how often one’s spouse has made dinner for them as the relations may be regarded as ‘Communal Sharing’. However, one may feel the need to reciprocate where an acquaintance is concerned if the relationship is thought of, at least partially, as reciprocal. ‘Market pricing’ concerns exchange values across different commodities and activities, and especially governs token exchanges (i.e. currency). While Fiske’s model does not explicitly concern itself with morality, moral debates may be framed according to how social relations should be regarded. For example, the highly moralised debate concerning individual roles in marriage over the last century in western communities may fairly be regarded as a question of the extent to which marriage should be conducted as an ‘Authority Ranking’ (the conservative or traditional position) arrangement or a ‘Communal Sharing’ relationship (the contemporary view). The latter position argues for the rights and autonomy of the individuals within the arrangement (Vogler & Pahl, 1994), while the former frequently argues from the perspective of a divine or social order (Dent, 2003).

When Shweder, Much, Mahapatra and Park (1997) developed a three factor moral taxon they also made a clear distinction between groups of values that were, by definition, incompatible; namely, individual and collective concerns. ‘Autonomy’ refers to the moral imperatives that centre on the individuals. Individuals should not be wantonly harmed, and they should receive distributive fairness, at least as it is understood in their cultural milieu. ‘Community’ refers to concerns for social cohesion, conformity, respect for authority and hierarchy, in essence those limitations on personal freedom that allow groups to function. In addition to the Autonomy and Community factors, which are analogous to Schwartz and Bilsky’s (1987) groupings discussed
earlier, Shwedeb et al. added the moral domain of ‘Divinity’. Divinity presupposes an inviolable supernatural order that should be respected via rites of worship, cleanliness, and ritual or rules of conduct concerning sexual matters and food (1997, p.147).

Most recently, Moral Foundations Theory (MFT; Graham, et al., 2011; Haidt, 2007; Haidt & Graham, 2007; Haidt & Joseph, 2004, 2006), incorporated the divisions proposed by Shwedeb et al., (1997), but divided ‘Autonomy’ into concerns about Fairness/equity as distinct from Care/beneficence. The Fairness foundation concerns preferences for equity of distribution regardless of social position. Items in the Moral Foundations Questionnaire (MFQ30) ‘Fair Scale’ (e.g. ‘It’s morally wrong that rich children inherit a lot of money while poor children inherit nothing’) indicate that respondents who score highly on this factor prefer that social relations be constructed on Fiske’s (1991) ‘Communal Sharing’, rather than the ‘Authority Ranking’ element. ‘Care’ concerns itself with nurturance and the prevention of harm to individuals, vulnerable ones in particular.

Concerns for social cohesion (‘Community’ or ‘Binding’ foundations) were also differentiated into concerns for ‘Ingroup Loyalty’, ‘Authority/Respect for Hierarchy’ and ‘Purity’. Ingroup Loyalty concerns itself with the preservation of—and devotion to—the group one is a member of, and is expressed as a preference for community wellbeing over one’s own goals in the MFQ30 (e.g. ‘It is more important to be a team player than to express oneself ’). ‘Authority’ refers to the perceived desirability of subordinating one’s individual judgment or desires where they conflict with the desires of authority figures (e.g. ‘If I were a soldier and disagreed with my commanding officer’s orders, I would obey anyway because that is my duty.’). Thus, respondents who agree with items in this scale express a preference that social relations should be organised according to Fiske’s (1991) ‘Authority Ranking’ element. Shwedeb and
colleagues (1997) ‘Divinity’ was subsumed into the ‘Binding’ moral foundations, and named ‘Purity/Sanctity’. Individuals who identify with concerns described by this moral foundation tend to endorse the other ‘binding’ foundations as well (Graham, Haidt, & Nosek, 2009; Graham et al., 2011). Violations of this foundation tend to elicit disgust. Recent research indicates high self-reported disgust sensitivity in respondents for whom the binding foundations are particularly important (Inbar, Pizarro & Bloom, 2009; Inbar, Pizarro, Iyer & Haidt, 2012).

A considerable body of research supports the five foundations theory. Sources of validation include analyses of responses to the Moral Foundations Questionnaire (MFQ41 & the modified MFQ30) from large international samples, content and linguistic analysis of political and religious speeches and texts from the United States (Graham et al., 2009), as well as analysis of the MFQ30’s predictive validity for membership of particular groups. For example, vegetarians are likely to score highly on the ‘Care’ foundation and political liberals are more likely to endorse the individual foundations relative to the binding foundations (Graham et al., 2009; Graham et al., 2011).

While all of Graham and colleagues’ (2011) moral foundations represent valuable contributions to the moral psychological literature, it seems the greatest discriminative value is to be found between the communal (collective, or binding) and the individualised foundations. For example, van Leeuwen and Park (2009) found in a correlational study with 140 undergraduate students that participants’ level of emphasis on the communal (binding) foundations, relative to their emphasis on individualising foundations, partially mediated the relationship between belief in a ‘dangerous world’ and political orientation. What is more, when Hirsh, DeYoung, Xu and Peterson (2010) employed the MFQ30 along with the Revised NEO Personality Inventory (NEO
PI-R) and Abridged Big Five circumplex (Hofstee, de Raad, & Goldberg, 1992) with 481 adults, they found that ‘Compassion’ (a second order factor of the Big Five construct of ‘Agreeableness’) was positively associated with participants’ scores on the individualising foundations of Fairness and Care, while ‘Orderliness’ and ‘Politeness’ scores were positively associated with the binding foundations of Authority and Loyalty. However, the Moral Foundations Theory is not without its critics. For example, Gray, Young and Waytz (2012) argued that the distinction between different types of moral concern is less important than the interpersonal and dyadic aspects that they believe unify conceptions of morality. While this is an interesting and innovative view, the Moral Foundations Theory has the advantage of having produced a standardised instrument for use in empirical investigations. While temporal discounting may have a relationship with Gray, Young and Waytz’s conceptualisation of morality, it would be difficult to investigate this at the present time.

While conceptions of morality will probably continue to evolve along with the growing field of moral psychology, the point to be drawn from the foregoing studies is that ‘morality’ as a single, nebulous construct is not sufficient for the study of individual differences in moral attitudes. Relative differences in concern for individual versus collectivist moral foundations predict differences in political attitudes (Haidt & Graham, 2007), world-view (van Leeuwen & Park, 2009) and personality (Hirsh, et al., 2010). Thus, it is likely that patterns of moral concerns—differences between individualising and binding foundations in particular—will be predictive of a range of other individual differences; one of which may include differences in individual impulsivity.
The role of educational attainment in moral attitudes.

One reason to suspect that differences in impulsivity\(^1\) may predict differences in individuals’ emphasis on individualising versus binding moral foundations lays in educational attainment. A considerable corpus of research describes robust (inverse) associations between temporal discounting rates and academic outcomes (Duckworth & Seligman, 2008; Kirby, Winston, & Santiesteban, 2005). Temporal discounting has also been implicated as a force in societal stratification—via educational attainment—in western post-industrial communities (Ehn, 2012). Ehn’s (2012) model of social stratification predicts that the more expensive education is (by nation) the greater the role temporal discounting rates will play in determining who persists with education rather than seeking immediate employment. Ehn’s model successfully accounted for 93% of the observed income based stratification in the countries surveyed. In sum, the lower one’s temporal discounting rate, the greater one’s education attainment, and by extension income, is likely to be.

But increased education does more than just increase long term income. Educational attainment is a significant predictor of liberal political orientations, characterised by higher tolerance for out-groups, as well as concern for individuals’ rights even where those rights may conflict with the interests of one’s own group (Bobo & Licari, 1989; Gaasholt & Togeby, 1995; Luguri, Napier, & Dovidio, 2012; Phelan, Link, Stueve, & Moore, 1995; Weakliem, 2002). Several explanations have been offered for the relationship. The developmental model (Lipset, 1981) argued that an increased concern for tolerance and individual rights was a—supposedly inevitable—product of increased education, arising from students’ cognitive and personal development as they progress through higher education. McClosky and Brill (1983),

\(^1\) Impulsivity is a broad construct, with some of the most recent analyses describing seven distinct types. In the following section we provide a justification for our measure of impulsivity—temporal discounting rates—and the types of impulsivity this indirect measure taps into.
in a notably less optimistic account, argued that higher education, like all institutions, requires that members take on the principles and attitudes that characterise membership of the group; these are transmitted via the more powerful members of the institution, on whom the students’ futures depend. Thus, education only increases liberal attitudes to the extent that the institution holds liberal attitudes (Phelan et al., 1995). Recent research provides some support for this ‘cultural transmission’ approach.

Inbar and Lammers (2012) recent study of social psychology faculties indicated a notable libertarian bias in academic posts; fewer social psychologists reported conservative attitudes than would be expected in the broader population. However, the libertarian bias only extended to social issues, not economic ones, a finding that is congruent with Jackman and Muha’s (1984) argument that libertarianism as it is passed on via education concerns itself with a focus on the rights and privileges of the individual, but not necessarily broader macro-economic status principles. Nevertheless, recent work by Luguri et al. (2012) indicated that conservative participants, when encouraged to answer questions—which were unrelated to ideology or morality—according to broad principles (‘abstract mindset’) showed significantly more tolerance for perceived out-groups than those in a ‘concrete mindset’ condition. To the extent that education develops the cognitive ability to reason according to principles transferred from one situation to another (abstract reasoning), Luguri and colleagues’ (2012) results may be viewed as support for the developmental account.

While the aforementioned accounts differ in terms of their objectives and mechanisms, they agree on the causal relationship. Greater education appears to result in more liberal attitudes, rather than liberal attitudes leading to more educational attainment. Liberal political attitudes are characterised by a greater concern for the rights of the individual than the binding moral foundations. Graham et al. (2011) took
the difference between average scores on their Individualising moral foundations (Fairness, Care) and the Binding moral foundations (Loyalty, Authority & Purity) as a measure of ‘Progressivism’, noting that respondents who tend toward liberal political affiliations tend to score higher on ‘Progressivism’ than those who supported more conservative political ideologies. Thus, it was predicted in the present thesis that lower impulsivity (measured via temporal discounting rates) would predict higher concerns for the Individualising moral foundations, primarily via education.

Identity and moral attitudes.

In light of Shariff and Norenzayan’s (2007) argument that an implicit sense of being observed may lead participants to behave according to their moral beliefs, we also reasoned that the relationships between temporal discounting and score on the moral foundations would be mediated by the importance of having, and being seen to have, a moral identity. It is a fair assumption that no-one wishes to present to their peers as immoral\(^2\), and the extent to which morality is part of one’s self-concept may influence how strongly participants report being concerned for particular values (e.g. loyalty or fairness). The more important being ‘moral’ is to one’s identity, the more strongly one is likely to endorse it.

To date, most explorations of moral identity have concerned themselves with moral behaviour (Aquino, Freeman, Reed, Lim, & Felps, 2009; Aquino & Reed, 2002; Bergman, 2002; Hart, 2005). Moreover, where references to moral attitudes have been made, they have generally assumed moral behaviours are driven by individualised moral attitudes (i.e. Fairness or Care). For example Moshman (2005) described the moral agent as one ‘who acts on the basis of respect and/or concern for the rights and/or welfare of others’ (our emphasis, p. 121). However, moral values such as

\(^2\) However, appearing as immoral to the values held by an ‘outgroup’ may, by contrast, be a marker of membership with one’s own group.
Loyalty, deference to Authority and Purity are also part of the vernacular as it pertains to identity. One may describe themselves as loyal, respectful, or even puritanical.

We suspected that, if Haidt and Kesebir (2010) are correct, and morality is associated with the ability to suppress selfishness, individuals with lower impulsivity (measured as temporal discounting rates) would be better able to act according to whatever social and moral mores they have internalised via their beliefs, culture or group membership. On observing themselves consistently being able to ‘do the right thing’, those with lower impulsivity will be more likely to regard moral conduct as a plank of their identity (Bem, 1967, 1972). In turn, low impulsivity individuals will regard moral rules as more important; at least important enough to act on.

Conversely, more impulsive individuals may have internalised moral rules but have trouble keeping to them. For example, suppose a young man has learned through his church, family or peer group that pre-marital sexual congress is immoral. However, when the opportunity arises the young man finds he is unable to muster the self-control to resist; and lapses repeatedly. He may seek help to change his behaviour. But—according to self-perception theory (Bem, 1967;1972)—he is just as likely to decide that he is not a very chaste person. Understandably, no one wants to see themselves as morally deficient; the easiest course is to conclude that chastity is not really such an important virtue. Thus, we predicted that highly impulsive individuals would score lower on measures of moral identity, mediating relationships between temporal discounting rates and scores on the moral foundations. Below, we provide an introduction to temporal discounting, the types of impulsivity it appears to represent, and a justification for its use as a measure of impulsivity in this thesis.
Temporal Discounting: An Introduction

Those who have been fortunate enough to attempt a doctoral thesis will readily acknowledge the lure of easier or more hedonistic activities when it comes time to write. The large but postponed reward of thesis completion easily overwhelms smaller pleasures in the planning and commitment stage; that is, before small distractions become immediately available. Unfortunately, one is often dismayed to find the snacks, the wine, and the beaches all make a highly corrosive comeback when they are immediately available. The motivational power, or value, of smaller but sooner rewards (SS) all too frequently stymie progress towards larger, but later rewards (LL). This behaviour is exploited to great effect in marketing via the ubiquitous ‘buy now – pay later’ stratagem. Behavioural change campaigns trying to appeal to people’s long term interests by environmental groups (Epstein, 2007; Gattig & Hendrickx, 2007) or health experts (Barlow, 2007) may prompt individuals to commit to new habits, such as taking the bus to work or dieting. However, these resolutions often fail when the convenience of driving to work, or a sweet treat become imminently available (Ainslie, 2002).

This tendency of future outcomes (positive or negative) to lose subjective value as a function of delay is termed temporal discounting (Soman et al., 2005; Stevenson, 1993). A robust and widespread phenomenon, temporal discounting (TD) has been demonstrated under very diverse conditions; rat and pigeon feeding behaviour (Green, Myerson, Holt, Slevin, & Estle, 2004), rats shock avoidance (Deluty, Whitehouse, Mellitz, & Hineline, 1983) human judgments in relation to monetary rewards (Raineri & Rachlin, 1993), perceived probability of an outcome (Rachlin, Raineri, & Cross, 1991), environmental risks (Gattig & Hendrickx, 2007) and valuation of public goods like water and infrastructure (Viscusi & Huber, 2006).
The tendency to change preferences from large later rewards (e.g. chapter completion) to small immediate rewards (e.g. glass of wine) when the latter become immediately available is referred to as dynamic inconsistency (Ainslie, 2001, p. 29). Dynamic inconsistency results from a ‘spike’ in the subjective value of the smaller reward (relative to the larger delayed reward) the closer it gets to the subject in time, until its present value exceeds the discounted value of the larger, later reward.

Theoretical models used to predict and explain temporal discounting and dynamic inconsistency should—ideally—be able to accommodate human and animal observations. Exponential and hyperbolic models are reviewed below, concluding with an argument for the hyperbolic model on these grounds.

**Exponential discounting.**

Exponential discounting is often referred to as ‘normative’ discounting, primarily because it is the formula that delivers the greatest ‘reward’ to the decision maker over the delay period (Schweighofer et al., 2006). In line with the assumption of evolutionary biologists that an organism will, as a matter of natural selection, tend toward behaviours that maximise their utility (gains for effort expended), it had been assumed by economists that human discounting rates should be exponential (Bickel & Johnson, 2003). Exponential discounting curves apply fixed, compounding rates of reduced value as a function of time until the reward (or consequence) is realised (Ainslie, 2001). Thus, the amount of ‘value’ the reward loses per unit of delay does not change and may be represented as follows:

\[ V = A(1 - k)^D \]

Equation 1 (Ainslie, 2001, p. 29)

Here \( V \) represents the value of the discounted reward \( A \), \( D \) the units of delay (days for example), and \( k \) the discounting rate in the unit interval. Exponential
discounting, under most conditions, produces consistent decision preferences. For example, if a decision maker prefers 25 dollars in 92 days over 20 dollars in 90 days, exponential discounting predicts that the participant will still prefer 25 dollars when there are only two days left to wait rather than 20 dollars without further delay. However, these assumptions are not supported by the observations. More often, human and animal subjects switch preferences when the small reward becomes imminently available (Ainslie, 2002; Green & Myerson, 1997, 2005).

**Exponential models require magnitude effects.**

Exponential models do not predict this frequently observed ‘dynamic inconsistency’ unless the rate of discounting is amount dependent, that is, if the discounting parameter ‘\( k \)’, is inversely proportional to the value of the undelayed amount ‘\( A \)’ (Green & Myerson, 1997, p. 499). Interestingly, the rate of discounting is amount dependent in humans, a phenomenon also referred to as a ‘magnitude effect’ (Green et al., 2004). In a repeated measures choice paradigm, Green, Myerson and McFadden (1997) asked human participants to choose between immediate smaller monetary rewards or larger later rewards. While the relative differences between the present and delayed values were held constant (e.g. $50 now or $100, compared to $500 now, or $1000 in one year), the absolute amounts of the delayed rewards were manipulated between $100 dollars and $100 000, with delays until receipt ranging from 3 months to 20 years. The authors describe significant temporal discounting at all magnitudes; however, larger amounts were not discounted as much as smaller ones. However, for Green and colleagues’ (1997) data, the patterns of discounting fit more accurately with the hyperbolic model—discussed below—than the exponential one.

Moreover, while reversals of preference have been demonstrated in animals (Green & Myerson, 1997; Rachlin & Green, 1972) magnitude effects have not been
reliably demonstrated. Grace (1999) manipulated the magnitude of rewards by altering the period of access to grain with four pigeons in a choice procedure where the birds chose between a short period of access sooner or a longer period of access to grain later. Once again, the relative sizes of the reward pairs were held constant. The rate of discounting \( k \) was not significantly greater for smaller rewards (Grace, 1999). In a replication of Grace’s (1999) study, Ong and White (2004) also failed to detect a magnitude effect in pigeons, while Green et al. (2004) failed to detect reliable magnitude effects in pigeons or rats. While magnitude effects could explain reversals of preference in humans, it cannot explain it in animals – making exponential models less parsimonious than the hyperbolic model.

In terms of ‘goodness of fit’, observed discounting curves for animals (Green & Myerson, 1997) and humans (Ainslie, 1992; Green & Myerson, 1997; Myerson & Green, 1995) are better accommodated by hyperbolic than exponential models. Hyperbolic models of discounting do not require the assumption of a magnitude effect, and fit the observed data more closely.

**Hyperbolic discounting.**

Like exponential discounting, hyperbolic models of temporal discounting predict that the subjective value of the delayed rewards will be inversely proportional to the length of the delay. Unlike exponential discounting, hyperbolic models also predict that the amount of discounting over each delay interval (e.g. days or hours) will be inversely proportional to the number of units of delay. For example, if one discounts 100 dollars *exponentially* at a discount rate \( k = 0.2 \), then the subjective value of the same amount after one unit of delay (e.g. one day) would be 80 dollars, 64 dollars after two units of delay, 51.20 after three units and so on. At each interval, the discount rate remains 20% of the remainder. After 20 units of delay at a discounting
rate of 0.2 at each interval, the exponential model would predict a subjective value of one dollar and eighty cents.

The same scenario under a hyperbolic model makes different predictions. The hyperbolic function may be expressed by the following:

$$ V = \frac{A}{1 + kD} $$

Equation 2 (Mazur, 1987)

In the above, the subjective ‘value’ of a future reward or stimulus (V) equals the undelayed amount of reward (A) divided by the sum of ‘1’ and the product of ‘rate of discounting’ (k) and the temporal delay (D). Both exponential and hyperbolic discounting parameters (k) are determined by a ‘point of indifference’ – when a smaller sooner (SS) reward and a larger later (LL) reward have, for the participant, subjectively equivalent value. To illustrate, suppose one is offered $100 tomorrow or $100 in three days. Normally, the more immediate reward will be considered preferable. This may not change if one is offered $110 in three days. At some point however the respondent will regard a greater, delayed sum as equivalent to a lesser but immediate amount. For this illustration, let’s say this amount is $160.00. Therefore the difference ($60.00) represents a quantitative measure of discounting. Let the delay intervals be represented in days (in this case D = 3 days) and the discounting factor (k) may be determined as:

$$ 100 = \frac{160}{1 + k3} $$

Solving for k, the discounting factor used for calculating decreased value between each temporal point equals 0.2. This resulting value for k may be extrapolated to represent discounted values for lesser or greater delay periods. Note that in the initial intervals the subjective values for exponential and hyperbolic models are not very different. However, additional reductions in subjective value—in the
hyperbolic model—get smaller as successive delays are added, producing the characteristic hyperbolic curve (Ainslie, 2001, p. 31). In the present example, the first delay results in a loss of 17% of the original value, however at the twentieth delay the loss of subjective value (19th - 20th day) is just 4% of the remainder, resulting in a predicted subjective value of 20 dollars rather than the one dollar and eighty cents predicted under exponential discounting.

A diverse body of empirical evidence indicates that rates of discounting among animals and humans are better described by hyperbolic models, and are generally inconsistent with predictions made by exponential accounts. Moreover, this appears to be the case for a diverse range of future rewards or consequences; not just money (Chapman, 1996; Chapman & Elstein, 1995; Hardisty & Weber, 2009). While hyperbolic discounting appears to be common among humans and animals, rates of discounting are highly variable and determined by a range of individual and situational factors such as cues of reward, framing effects and interoceptive states (Odum & Baumann, 2010).

**Challenges to the hyperbolic temporal discounting model.**

The hyperbolic model has not escaped criticism entirely. Read (2001; Read & Roelofsma, 2003) argued that changes in decision preferences do not require hyperbolic discounting, and that observations explained by hyperbolic discounting are possibly an artefact of the methodology used to measure rates of subjective value decay. In particular, Read (2001) argues that discounting is sub-additive. That is to say that the claim made by proponents of the hyperbolic model, that decision-makers are more patient when neither the small rewards or the later larger rewards are available (say, at 30 and 32 days delay) than when the early reward is imminently
available, is an artefact of confounding the whole interval (entire time until latest reward is available) with the delay between the earlier and later rewards (p. 305).

By examining individual discounting rates over different delay lengths, set within overall interval of up to 36 months, Read (2001) argued that discounting rates were higher for shorter delays regardless of whether the delays between rewards began immediately or whether both rewards became available later in the overall interval period. Thus, the authors concluded that the hyperbolic prediction of increasing patience as a function of delay represents a misinterpretation of the observations. Notwithstanding, the study did find evidence of discounting congruent with the hyperbolic model, but only using the matching (e.g. ‘How much would you pay today, to receive $25 in 10 days?’), rather than the choice titration procedure (e.g. ‘Would you prefer $10 now or $100 in one month?’). For these reasons, the research presented in this thesis adopted a matching procedure for studies conducted in the laboratory (Chapters 3, 4, 5 & 6). Although hyperbolic models were found to provide a superior fit to the data than exponential models in all cases, data were also analysed using an atheoretical ‘Area Under the Curve’ (AUC) method (Myerson, Green, & Warusawitharana, 2001) in Chapters 4, 5 and 6. This approach measure discounting as a function of the area under a plotted data curve, but makes no predictions about the shape of the curve.

**Temporal discounting as a measure of impulsivity.**

There are several self-report measures of impulsivity available, such as the Barratt Impulsivity Scale (BIS; Barratt, 1965, 1985; Patton, Stanford, & Barratt, 1995) or the Impulsivity Scale – version 7 (I7; Eysenck & Eysenck, 1978). These are useful instruments, but there are two reasons to suspect that they may not capture the self-defeating impulsivity that bedevil long term commitments like dieting, saving,
conserving resources or overcoming addiction (Ainslie, 2002, 2009; Monterosso & Ainslie, 2007). The first involves social desirability bias. Impulsivity (a failure to eat with restraint for instance) has entered the vernacular as a by-word for a lack of discipline or irresponsibility. Baumeister and Exline (1999) argued that ‘vice signifies the failure of self-control, while virtue involves the consistent, disciplined exercise of self-control’ (p. 1189). It is reasonable to expect that respondents might understate self-reports of impulsivity that betray tendencies toward embarrassing excesses of behaviour. Moreover, as humans routinely overestimate their abilities in almost all domains (Johnson & Fowler, 2011), there is no reason to expect that self-control should be an exception, especially given the moral connotations associated with self-control.

The second reason concerns the recursive nature of predicting one’s behaviour; that is to say that predictions about our behaviour become a source of input into those decisions (Ainslie, 2009). In sum, self-presentation and recursive self-prediction encourage participants to respond to self-report measures according to how they think they should behave, but for slightly different reasons. Thus, self-reports of impulsivity should be complemented by more indirect measures, such as temporal discounting rates.

While temporal discounting rates are subject to ‘spectacular variation’ (Frederick, Loewenstein, & O'Donoghue, 2003, p. 14) observations of discounting in humans demonstrate some reliable characteristics. For example, inverse relationships are reliably detected between temporal discounting rates and age (Green, Fry, & Myerson, 1994; Green, Myerson, Lichtman, Rosen, & Fry, 1996), education (Green et al., 1994; Green et al., 1996; Reimers, Maylor, Stewart, & Chater, 2009), and IQ (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007). Moreover, temporal discounting rates provide a reliable behavioural measure of the kind of impulsivity that is of
particular interest to the science of behavioural change; self-defeating or dysfunctional impulsivity (Ainslie, 2001). Positive correlations between temporal discounting rates and addiction (Mitchell, 1999; Murphy, Vuchinich, & Simpson, 2001), relationship infidelity and earlier sexual intercourse (Reimers et al., 2009) have also been demonstrated. Conversely, Duckworth and Seligman (2008) found that discounting rates predicted academic achievement in eighth grade school children better than IQ, while Kirby, Winston and Santiesteban (2005) described an inverse relationship between temporal discounting rates and college students' grade point averages.

Further evidence that temporal discounting taps into the sort of behaviours that are regarded as 'moral' issues arises from detailed factor analyses of self-report measures. While discounting rates do not correlate highly with self-report measures (McLeish & Oxoby, 2007), they do correlate with some isolated factors that are worth noting. Kirby and Finch (2010) tested items from every widely used self-report impulsivity scale. They concluded that temporal discounting rates measured by the Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996) loaded heavily on only one of seven factors; namely, 'Impatiently Pleasure Seeking'. While one item on this factor refers specifically to immorality, other items ask participants about the desirability of premarital sex, drug use, and gambling, all of which frequently enter public discourse in morally loaded terms. It is interesting to note the relationship between temporal discounting and self-reports of behaviours that have such moral connotations. Miller, Joseph, and Tudway (2004) also assessed the component structure of popular impulsivity self-report measures, arguing for a three-factor solution. Interestingly, there was considerable overlap between their factor

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3 The other impulsivity factors identified by Kirby and Finch (2010) included Prepared/Careful, Impetuous, Divertible, Thrill and Risk Seeking, Happy-Go-Lucky, and Reserved.

We agree with Kirby and Finch (2010) that personality theory generally, and impulsivity research in particular, have much to gain from the use of indirect (or behavioural) measures as a complement to self-reports (direct measures). To this end, temporal discounting rates were used in the present research, whereby it is understood that we refer to ‘dysfunctional’ and/or ‘impatient and pleasure seeking’ impulsivity. We submit that hypothetical temporal discounting measures represent an indirect measure of impulsivity. Discounting measures where money is genuinely at stake may be regarded as behavioural.

The Effects of Moral Concepts on Temporal Discounting Rates

Moral concepts in the study of religion.

Studies of moral concepts have been something of a sideshow in the rapidly growing literature concerning the effect of priming religious concepts. When Shariff and Norenzayan (2007) presented participants with 10 one-dollar coins, giving them the opportunity to donate some of these coins to anonymous receivers, they found that participants primed with religious concepts gave more coins than control participants did. Their second study showed that priming with secular moral concepts produced a similar result. Shariff and Norenzayan concluded that religious primes “aroused an imagined presence of supernatural watchers … this perception then increased prosocial behavior” (p. 807). Thus, the vigilance produced by imagined observation caused participants to behave according to whatever moral rules they believed were relevant (e.g. beneficence, equity of distribution or loyalty to fellow students). Randolph-Seng and Nielsen (2008), on the other hand, argued that religious and moral ideas share some representational overlap; thus, religion activated moral ideas via
spreading cognitive activation (Collins & Loftus, 1975). Arguing that the moral primes used should not have activated the idea of surveillance, Randolph-Seng and Nielsen (p. 3) concluded there is nothing special about religious (compared to secular moral) ideas. Pichon, Boccato, and Saroglou (2007) primed participants with positively valenced religious concepts, finding that the primes appeared to increase accessibility to secular moral concepts in a subsequent lexical decision task (Study Two).

While Pichon and colleague’s finding lends itself to the latter account, we note that Shariff and Norenzayan’s (2007) secular moral prime used words frequently associated with the detection of misdeeds. ‘Police’ for instance is not only a noun, but a verb, meaning to maintain surveillance in the interest of detecting rule-breaking. As McKay and Dennett (2009) point out, items like this could activate the notion of being watched. While Randolph-Seng and Nielsen (2008) argued that—setting notions of surveillance aside—moral concepts should have similar behavioural effects as religious ones, Shariff and Norenzayan (2007) contend that the notion of surveillance is required. Gervais and Norenzayan’s (2012) recent work lends support to this ‘supernatural monitoring hypothesis’; explicit and implicit exposure to God related concepts increased participants social self-consciousness (Studies One and Two) and increased the incidence of socially desirable responding (Study Three).

More recently, Rounding et al. (2012) found that priming participants with moral concepts produced performance on a subsequent Stroop test that was not significantly different from the performance produced by priming with Shariff and Norenzayan’s (2007) religion primes. While performance in Rounding and colleague’s religion condition was significantly better than for participants in their control condition, performance in the moral condition was not significantly different
from either. This unexpected, but equivocal, result prompted Rounding et al. (2012) to call for focused studies of the effects of moral concepts on subsequent behaviour.

While all four of Rounding and colleagues’ studies are relevant to the present topic, of particular interest is their second study. Following the priming tasks (Religion or Neutral), participants were given two options. Return the following day to collect an honorarium of $5, or return a week later and collect $6. Those primed with religious items were more likely to wait than those who were not. The authors concluded that religious concepts may provide ‘important psychological nutrients’ (p. 645), replenishing self-control, thus allowing the participants in the religion condition to do what control participants could not – wait for a larger sum. The implication is that the religious primes reduced participants’ impulsivity (temporal discounting rates) such that they were rendered able to be patient. In Chapter 6, we test this proposition using a moral and a religious priming condition. Moreover, we argue that Rounding and colleagues’ effects were likely the result of the activation of reputational concerns, increasing the motivation to appear patient, rather than the ability to wait for an extra dollar in one week. Such an explanation, we contend, is more congruent with the temporal discounting literature (Green et al., 1997) and the religious priming literature (Pichon et al., 2007; Shariff & Norenzayan, 2007, 2011). Moreover, motivational explanations accord well with recent models of self-control which do not rely on a resource refuelling metaphor, but rather describe self-control as an ongoing computational process whereby effort causes a shift in desire to continue as well as a shift in attention (Inzlicht & Schmeichel, 2012). Alternatives to the resource-refuelling model of self-control are discussed at length in Chapters 6 and 7. In Chapter 6, it was also of interest to determine whether secular moral concepts that did
not imply surveillance (e.g. police) or retribution (e.g. courts) would produce effects similar to those produced by religious concepts.

Moral problems and reduced discounting: Implications from environmental psychology.

Although there have been no direct tests of the effect of moral concepts on temporal discounting rates, a corpus of research from the environmental psychology literature claims to have observed the reduction of temporal discounting in response to environmental issues (Böhm & Pfister, 2005; Gattig & Hendrickx, 2007; Hendrickx & Nicolaij, 2004). Böhm and Pfister (2005) hypothesised that the causal structure of ‘environmental loss’ scenarios would direct the evaluative focus of participants in judgments of risk, kinds of emotions experienced and action tendencies (which actions the participants would like to take). According to Böhm’s (2003) ‘dual route’ model, where environmental losses are the result of a deliberate human action, the evaluative focus would be directed to the agent and their wrongdoing in the present (the ‘ethical’ evaluation route), more than the consequences, which could be delayed. Environmental loss scenarios without an obvious human cause would direct evaluative focus toward the consequence; this was described as the ‘consequentialist route’.

Böhm and Pfister (2005) reasoned that if this is the case, then manipulations of delays until the consequences are realised should affect evaluations of risk and emotional reaction only if there is no nefarious human cause. Where there is such a cause, the attention and judgment will focus on the wrongdoers, and evaluations will not be affected by temporal manipulation of the environmental consequences. Böhm and Pfister (2005) assessed—by self-report—participants’ responses to fictional news articles describing environmental disasters, the consequences of which were delayed by varying degrees. In one condition the disasters were caused by human
wrongdoing, in the other condition they were caused by natural events. While ratings of concern and anger showed weak but significant reductions as a function of subjective perceptions of delay (e.g. ratings of whether participants thought ‘one year’ was a long time in the future) for the ‘natural cause’ condition, no such reduction was detected in the ‘human cause’ condition. The authors concluded ‘environmental risks, due to their strong moral component, are partly immune to time perspective’ (p. 461). This interpretation of course assumes that moral concerns are capable of suspending the effects of temporal manipulation. However, this remains to be demonstrated.

The authors of this and similar studies investigating environmental ethical problems and temporal discounting (Böh, 2003; Böh & Pfister, 2005; Gattig & Hendrickx, 2007; Hendrickx & Nicolaij, 2004) accept statistically significant reductions in the dependent variables as demonstration of discounting. Demonstration of ‘non’ discounting relies, at least in part, upon a null result. In Böh and Pfister’s (2005) study, if the respondent’s judgment of seriousness and emotional responses to the ‘man made’ loss did not significantly differ as a function of delay, temporal discounting was judged not to have occurred. However, the changes in the dependent variables for the ‘natural causes’ condition were weak; it is equally likely that low statistical power accounts for the failure to reject the null hypothesis.

Non-detection of discounting and the reduction of impulsivity.

Another problem for Böh and Pfister’s (2005) conclusion is that recent work by Crockett et al (2010) has demonstrated that when presented with perceived wrongdoing, the desire to punish (demonstrated behaviourally by Crockett et al, and measured by self-report in Böh & Pfister) tends to be associated with higher—not lower—temporal discounting rates. With Böh and Pfister’s design it was possible to
produce an *increase* in impulsivity base level impulsivity (or no effect at all) and then, detecting no change across conditions conclude correctly that the temporal manipulation had no effect. Although the authors did not explicitly suggest reductions in impulsivity as a result of their manipulation, it is difficult to imagine how increases in impulsivity could be helpful to environmental behaviour campaigns which frequently ask people to suppress the impulse to have long showers, or throw recyclables in the trash in the service of uncertain, temporally distant and nebulous long-term goals. It would be helpful to have a clearer picture of the effects—if any—moral concepts have on temporal discounting rates.

**Do social desirability biases confound the measurement of moral effects on discounting rates?**

Moreover, our alternative explanation for Rounding and colleagues’ (2012) findings—reputational concerns leading to socially desirable responding—could as easily apply to Böhm and Pfister (2005). In both studies, it required little imagination to guess which response was likely to cast one in a favourable light. Environmental issues of all kinds have taken on a broader moral status in western communities, to the extent that environmental psychological researchers have developed measures to determine which arena of values (moral or otherwise) environmental concerns fall into (Lindenberg & Steg, 2007; Thompson & Barton, 1994; Vlek, 2000; Vlek & Steg, 2007). In the human induced conditions of Böhm and Pfister’s (2005) study, public goods (coastline, ocean) were destroyed as a result of human negligence. Whether one construes this scenario as the violation of the sacred natural world (Purity), the denial of an appropriate share of public wealth to others (Fairness), cruelty to the animals and people that depend on those resources (Care) or violation of relevant laws and rules (Authority), it presents as a moral violation of one kind or another. The
authors correctly acknowledge this, but then appear to overlook the parsimonious explanation of social desirability and reputational concern. The reported moral acceptability of misdeeds is affected by reputational concerns (Bourrat, Baumard, & McKay, 2011), and such an explanation need not rely on changes to temporal discounting rates that are yet to be demonstrated directly.

Interestingly, Hardisty and Weber (2009) assessed temporal discounting rates for environmental, monetary and health outcomes, finding that environmental gains and losses were discounted at rates very similar to discounting rates for money. The primary differences between theirs and Böhm and Pfister’s (2005) studies were that Hardisty and Weber described no transgressions; respondents were simply asked to decide between environmental policies that would deliver varying environmental improvements/losses either immediately or after a delay. More importantly perhaps, the dependent variables (selected options) were relatively opaque in terms of social desirability. Where it is almost always socially desirable to be indignant about the desecration/waste of public goods (as in Böhm and Pfister [2005]), it was not obvious which response would cast the respondent in the best light. For instance, one item asked whether respondents would prefer an improvement in air quality in one year for 35 days or immediately for 21 days.

While Böhm and Pfister (2005) refer to morality rather than religion, they—like Rounding et al. (2012)—imply in their respective conclusions that the activation of particular social concepts (moral transgression in the former and religion in the latter case) have the power to reduce temporal discounting rates. Such a testable but important idea deserves direct investigation. We contend the foregoing review presents a surprising picture; to date, there is little direct evidence that the activation of secular moral or religious ideas can reduce or suspend temporal discounting.
Primming participants with secular moral concepts that are not confounded with potential surveillance cues (as in Shariff & Norenzayan), as well as using a formal and opaque measure of temporal discounting rates would progress the issue. Chapter 5 not only provides a direct test of the effect of moral concepts on temporal discounting rates, it also selects those concepts from a single moral foundation (Fairness; Graham et al., 2011). Surprisingly, within group increases in temporal discounting were detected following priming with secular moral concepts. We conclude Chapter 5 with a speculation of why this may be the case, and attempt to reconcile the finding with the present literature.

Chapter 6 presents an attempted replication of the effects detected in Chapter five, and adds Shariff and Norenzayan’s (2007) religion prime. The final study (Chapter 7) details two priming studies, the results of which account for the differences in results between the studies reported in Chapters 5 and 6; sounding a note of caution in terms of what might be an underappreciated potential confound in the supraliminal priming literature.
References


Chapter 2

Temporal Discounting and Moral Foundations
Abstract

In spite of Haidt’s (2007) proposal that moral psychology research should include collective and sacred moral concerns, studies examining impulsivity and morality are yet to include this broader moral taxon. Examination of the associations between impulsivity and five moral foundations—from the eponymous Moral Foundations Theory—may progress the issue. While the purpose of the present study was primarily exploratory, the extant literature allowed for some key predictions. For example, it was predicted that education would mediate relationships between impulsivity and the Individualising—but not the Binding—moral foundations. It was also predicted that participants’ sense of the importance of a moral identity would mediate both. Two hundred participants completed the Monetary Choice Questionnaire (MCQ), the Moral Foundations Questionnaire (MFQ), and the Self Importance of Moral Identity scale (IMI). Zimbardo’s Time Perspective Inventory (ZTPI) was included to explore the extent to which attitudes toward time, and decisions about delayed rewards, diverge. The expected mediation effects were not detected. There was a positive, but indirect, relationship between Discounting rates and the Individualising Foundations, via Internalised Importance of Moral Identity. Discounting rates were inversely correlated with a Future time-perspective, and were positively associated with a Present Fatalistic time-perspective. Discounting rates did not uniquely contribute to scores on the IMI when subjective time-perspectives (ZTPI) were accounted for. Thus the results probably reflect relationships between attitudes to time—rather than decisions about delayed rewards—and Importance of Moral Identity. Future work might include decisions about real monetary exchanges, instead of the hypothetical exchanges investigated here.
Temporal Discounting and Moral Foundations.

Over the last decade, studies concerning stable correlates between impulsivity and social behaviour have proven a fruitful field of research (Critchfield & Atteberry, 2003; Critchfield & Kollins, 2001; Curry, Price, & Price, 2008; Yi, Johnson, & Bickel, 2005). While these studies have provided fascinating insights into apparently moral behaviours, the varieties of moral attitudes that may (or may not) support pro-social behaviour—and their associations with impulsivity—are not well understood.

While studies of moral attitudes have tended to focus on what Graham, Haidt, Iyer, Koleva and Ditto (2011) call the ‘Individualising’ foundations, the claim that morality is not a unitary concept but—like memory—refers to diverse emotional and cognitive processes is not controversial (Sinnott-Armstrong, 2007, 2008). Thus, investigations into moral concerns might profitably be ‘fractionated’ into a suite of questions that must deal separately with each construct (e.g., fairness, sanctity) of the moral taxonomy the researcher selects (Whitehouse & McKay, submitted). The primary aim of the present study was to examine the relationship between temporal discounting rates (as a measure of impulsivity), and the five moral foundations described by Moral Foundation Theory (Graham et al., 2011); namely Care for others, equality and Fairness, In-group Loyalty, respect for Authority and Purity. The ‘Importance of Moral Identity’ (IMI; Aquino & Reed, 2002) and ‘Zimbardo’s Time Perspective Inventory’ (ZTPI; Zimbardo & Boyd, 1999) scales were included as a potential mediator in the former case, and an exploratory measure in the latter. We address the measurement of impulsivity and moral psychology theory below.
Temporal Discounting: A Measure of Impulsivity

There are several self-report measures of impulsivity available, such as the Barratt Impulsivity Scale (BIS; Barratt, 1965, 1985; Patton, Stanford, & Barratt, 1995) or the Impulsivity Scale – version 7 (I7; Eysenck & Eysenck, 1978). Although these are useful instruments, there are two reasons to suspect that they may not capture the kind of self-defeating impulsivity that bedevils long term goals like dieting, conserving resources or overcoming addiction (Ainslie, 2002, 2009; Monterosso & Ainslie, 2007). The first involves social desirability bias. Impulsive behaviours (a failure to eat with planned restraint for instance) have entered the vernacular as a by-word for a lack of discipline or vice. Baumeister and Exline (1999) go so far as to claim that ‘vice signifies the failure of self-control, while virtue involves the consistent, disciplined exercise of self-control’ (p. 1189). It is reasonable to expect that respondents might understate self-reports of impulsivity that betray tendencies toward embarrassing behavioural excesses. Further, people routinely overestimate their abilities in almost all domains, and there is no reason to expect that self-control should be an exception (Johnson & Fowler, 2011).

The second reason concerns the recursive nature of predicting one’s behaviour; that is to say that predictions about one’s own behaviour become, in themselves, a determinant of the behaviour. Thus, it is better to overestimate our ability to stick to long-term goals than underestimate it. If someone had asked the author this morning how the day would be spent, the answer would have been that the entire day will be spent writing. Alas, an hour was spent woodworking. While distractions are normal, it could be disastrous to pre-empt these distractions ahead of time. Giving oneself tacit permission to stray from long-term goals tends to lower the chances that one might stay on task (Ainslie, 2009). In sum, self-presentation and recursive self-prediction
encourage participants to describe how they believe they should behave. It is therefore not surprising that indirect impulsivity measures (e.g. temporal discounting rates) do not correlate highly with self-report measures like the Barratt Impulsivity Scale (BIS II) (McLeish & Oxoby, 2007).

Temporal discounting rates provide a quantified assessment of the extent to which a rewarding (or aversive) event loses subjective value as a function of delay (Ainslie, 2002). In experimental contexts the delayed reward is most frequently money, an easily quantifiable proxy for whatever reward participants desire\(^4\). Moreover, temporal discounting rates measure of the kind of impulsivity that is of concern to those interested in behavioural change; self-defeating impulsivity (Ainslie, 2001). Kirby and Finch (2010) tested items and subscales from widely used self-report impulsivity scales, finding that temporal discounting rates loaded heavily on only one—of seven—impulsivity factors extracted from the scales used; namely, ‘Impatiently Pleasure Seeking’. One item loading on this factor refers specifically to immorality, while other items ask participants about the desirability of premarital sex, drug use, and gambling, all which frequently enter public discourse in morally loaded terms. Miller, Joseph and Tudway (2004) also assessed the component structure of popular impulsivity self-report measures, arguing for a three-factor solution. Interestingly, their factor, ‘Nonplanned/Dysfunctional Impulsivity’ included the instrument scales included in Kirby and Finch’s (2010) ‘Impatiently Pleasure Seeking’ factor.

Taking the above into account, we submit that temporal discounting represents an indirect measure of the kind of impulsivity most relevant to moral decisions and judgments. Thus, temporal discounting rates were used in the present research, whereby

\(^4\)It should be noted that discounting rates for other rewards such as licit drugs (Baker, Johnson, & Bickel, 2003; Mitchell, 2004; Richards, Zhang, Mitchell, & de Wit, 1999), health (Chapman, 1996; Chapman & Elstein, 1995) or environmental outcomes (Hardisty & Weber, 2009) may differ from those for money.
it is understood that in the present context we refer to non-planned and/or pleasure seeking impulsivity.

**Development of Moral Taxonomies**

While it is widely accepted that morality refers to a suite of concerns, intuitions and internalised social rules (Gilligan, 1982; Schwartz & Bilsky, 1987; Sinnott-Armstrong, 2007), there is less agreement about what the moral taxon should include. Indeed, it is not clear where the boundaries should be drawn between ‘moralties’, or even if boundaries between morality and social convention are warranted (Fiske, 1991; Rai & Fiske, 2011).

While Schwartz and Bilsky’s (1987) work on describing a universal set of human values included but did not restrict itself to issues of morality, their ‘values theory’ did distinguish between values that centred on concerns for individuals (e.g. ‘self-direction’) versus communal goals (‘conformity’, p. 554). When Shweder, Much, Mahapatra and Park (1997) argued for a three part taxonomy of morality they also distinguished between individual and collective concerns. ‘Autonomy’ referred to moral concerns that individuals should not be harmed, and should receive a just share of public goods and opportunities (as prescribed by their cultural milieu). ‘Community’ referred to concerns for social cohesion, conformity, respect for authority and hierarchy; limits on personal autonomy that allow groups to function. In addition, Shweder et al. (1997, p.147) added the moral domain of ‘Divinity’, which presupposes an inviolable supernatural order which should be respected via rites of worship, cleanliness, ritual or rules of conduct concerning sexual matters and food.

(2011) argued that ‘Individualising’ concerns could usefully be divided into concerns about Fairness/Equity as distinct from Care/Beneficence. Concerns for social cohesion (the ‘Binding’ foundations) were divided into concerns for ‘In-group Loyalty’, ‘Respect for Hierarchy’ and ‘Purity/Sanctity’. The factor structure has been well validated and the Moral Foundations Questionnaire displays adequate internal reliability (MFQ31; Graham, Haidt & Nosek, 2009). The instrument is designed to assess which issues respondents take into account when deciding whether an action or attitude is ‘right’ or ‘wrong’.

Recent work with the Moral Foundations Questionnaire has detected some interesting distinctions between the Individualising (Fair & Care) and the Binding (Authority, Loyalty & Purity) foundations. In a correlational study with 140 undergraduate students, van Leeuwen and Park (2009) found that participants’ level of emphasis on the Binding foundations, relative to their emphasis on Individualising foundations, partially moderated the relationship between belief in a ‘dangerous world’ and political orientation. Hirsh, DeYoung, Xu, and Peterson (2010) employed the MFQ along with the Revised NEO Personality Inventory (NEO PI-R) and Abridged Big Five circumplex (Hofstee, De Raad, & Goldberg, 1992) with 481 adults in the United States, finding that ‘Compassion’ (a second order factor of the Big Five construct of ‘Agreeableness’) was positively associated with participants’ scores on the Individualising foundations of Equality and Care, while scores on the Binding foundations of Authority and Loyalty were positively associated with the personality factors of ‘Orderliness’ and ‘Politeness’.

The foregoing studies permit the conclusion that ‘morality’ as a nebulous concept is not sufficient for the study of personality or political attitudes. Patterns of responding to the five moral concerns reliably predict differences in political attitudes
(Haidt & Graham, 2006), world view (van Leeuwen & Park, 2009) and personality (Hirsh et al., 2010), particularly with regard to the Individualising versus the Binding foundations.

If self-control is related to virtue, as Baumeister and Exline (1999) propose, there is reason to suspect a relationship between temporal discounting rates and moral attitudes. However, in light of the foregoing studies, there is no reason to assume that individual temporal discounting rates should have the same relationship with Binding and Individualising foundations. For example, a concern to assist others (Care) might lead to the impulse to give to an overseas charity, while parochialism (Loyalty) might restrain that impulse in favour of finding and donating to a local charity. While a few studies have provided insights into the relations between discounting rates and prosocial behaviours, it is less clear which moral attitudes or concerns motivate those behaviours.

Curry et al. (2008), had respondents complete the Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996) and take part in an anonymous ‘public goods’ game whereby respondents could keep a stake they had been provided with, or contribute to a communal fund which would be doubled and redistributed among the players (regardless of their own contribution). As the game provides a pecuniary incentive to contribute less, higher contributions are interpreted as ‘pro-social’. The authors found that lower discounting rates predicted greater contribution. However, it cannot be determined which moral foundation (if any) influenced participants’ contributions. Participants did not know who was in their group, but ingroup loyalty is rarely, if ever, contingent on knowing all members of one’s group. Thus, a sense of loyalty to the group may have influenced the decision to contribute. On the other hand, it might not feel fair to take communal earnings knowing you had
contributed little (Fairness/Reciprocity). It was made clear that participants were allowed to keep their money or contribute; this might have alerted participants to the fact that the researchers were interested in their level of contribution. Although care was taken that responses were anonymous, demand characteristics and reputational concerns cannot be completely ruled out (potentially a role for Authority/Hierarchy concern) (Hayley & Fessler, 2005). Rai and Fiske (2011) argue that moral psychology stands to gain little explanatory power without an understanding of how the subject construes the nature of the relationship within which the act took place (p. 57). For example, one may feel it is permissible to charge an associate to help them fix their roof (reciprocity of exchange), but unthinkable to charge one’s mother (respect for hierarchy). Therefore we suggest that behavioural studies may be complemented by observations of relationships between individual impulsivity rates and particular moral concerns/intuitions.

**Time Perspectives and Moral Attitudes**

It was also of interest whether one’s attitude to how time should be spent is associated with participants’ responses to the moral foundations questionnaire, which is after all a measure of moral attitudes. For instance, might an individual who scores very highly on the Present Hedonism scale value the rights of the Individual (freedoms) over the Binding foundations (responsibility)? Since self-reports of impulsivity and temporal discounting do not reliably agree—as discussed earlier—we could not ignore the possibility that moral behaviours and moral attitudes may display similar divergence. The literature indicates that some moral behaviours accord with temporal discounting rates (as demonstrated by Crockett, Clark, Liebermann, Tabibnia, & Robbins, 2010; Curry et al., 2008; Yi, Johnson & Bickel, 2005). However, it may be
that moral attitudes are better associated with attitudes to time than to temporal
dISCOUNTING rates.

To this end, Zimbardo’s Time Perspective Inventory (ZTPI; Zimbardo & Boyd,
1999) was included in the present study. Previous studies have either found no
relationship between discounting rates and time perspectives (Taj, Mokri, & Fotohi,
2005) or only weak associations between discounting rates and the Future and Present
(Fatalistic and Hedonistic) scales (Daugherty & Brase, 2010). While this was an
exploratory aspect of the present study, it was included to detect possible divergence
between attitudes and actual decisions.

Identity and Education as Potential Mediators

Assuming a relationship between discounting rates and moral attitudes is
detected, the literature points to a couple of important mediating variables. For
example, higher endorsement of a moral attitude of any description arguably betrays the
desire to possess it. But it does not presuppose that it is part of one’s self-concept
(Aquino & Reed, 2002; Hardy & Carlo, 2005). One might believe a moral rule matters,
but also confess that they do not behave accordingly. For example, the author may
believe it is important to eat chocolate with restraint, but too many failures have
amassed in memory for the author to call himself a disciplined consumer.

However, those with lower impulsivity may be better able to behave according to
their beliefs (e.g. eating with restraint). Self-perception theory (Bem, 1967, 1972)
suggests that observing oneself showing appropriate restraint in order to ‘do the right
thing’ would allow moral attitudes to become part of one’s concept: ‘I act with
restraint, so it must be important’. Of course, if morality is part of one’s self concept,
self-presentation should influence respondents to endorse items on the Moral
Foundations Questionnaire more highly than those for whom a moral identity is not as
salient (Gilbert & Jones, 1986; Johnson, 1981). In sum, 'I have this good quality, so it is very important' versus the alternative 'I do not have this good quality, so it probably doesn’t matter very much'.

![Diagram of the relationship between temporal discounting, moral identity, and self-concept](image)

**Figure 1. Importance of Moral Identity Mediates the Relationship Between Discounting and Moral Concerns.**

The 'Importance of Moral Identity' scale (IMI; Aquino & Reed, 2002) was included in the present study as a means of determining, by self-report, the extent to which 'being moral' was a part of respondents' self-concept. It was predicted that relationships between discounting rates and moral foundations would be increased as a function of higher endorsement of the IMI scales. While we predicted the mediating role of moral identity would be the same for all of the moral foundations, we were also interested in mediators that might shed light on the divergent characteristics of the Individualising and the Binding moral foundations.

Education is an important predictor variable for liberalism and tolerance of out-groups as well as temporal discounting rates. Higher temporal discounting rates are associated with lower educational attainment (Reimers, Maylor, Stewart, & Chater, 2009), an association that may be explained in two, compatible ways. It is possible that, seeing the future payoffs, those with lower temporal discounting rates persist with education, denying themselves the short term rewards of greater income and leisure time. Temporal discounting rates are also inversely associated with grades in early high school and university (Duckworth & Seligman, 2008; Kirby, Winston, & Santiesteban, 2005). Thus, those with low temporal discounting rates are more likely to
receive grades that encourage them to persist with an extended educational career. Alternatively, greater education may teach discipline and the value of patience.

While the mechanisms are still a matter of debate, the positive relationship between educational attainment, political liberalism and tolerance of out-groups has been well established (Gaasholt & Togeby, 1995; Graham, Haidt & Nosek, 2009; Haidt & Graham, 2006; Jenssen & Engesbak, 1994; Weakliem, 2002). Respondents with liberal and tolerant orientations are more likely to endorse the ‘Individualising’ foundations of the Moral Foundations Questionnaire more than the ‘Binding’ moral foundations (Graham et al., 2009; Graham et al., 2011). Those with more conservative orientations on the other hand, tend to endorse all moral foundations relatively equally. Thus, the MFQ’s sixth scale—Progressivism—represents the difference between scores for ‘Fair’ and ‘Care’ scales and scores for the ‘Authority’, ‘Loyalty’ and ‘Purity’ scales (Graham & Haidt, 2009).

Gaasholt and Togeby (1995) as well as Weakliem (2002) suggest that increased educational experience fosters the ability to accommodate abstract ideas and principles, or exposes students to a liberal culture, which they are encouraged to emulate. More recently, studies by Luguri, Napier, and Dovidio (2012) presented evidence that encouraging participants to adopt an abstract mindset increased tolerance of out-groups among otherwise conservative respondents. Both explanations indicate that education is the cause rather than the result of liberal attitudes. Thus, we predicted that the relationship between temporal discounting rates and the Individualised—but not the Binding—moral foundations would be mediated by education level. Specifically, discounting rates would have an inverse relationship with education. Education, in turn, would have a positive relationship with the Individualising foundations and
Progressivism scores by virtue of the fact that education appears to increase endorsement of those scales.

Method

Participants

Two hundred adult respondents (164 female) with a mean age of 36.22 years (SD = 12.08) took part in an online study. One hundred and eighty seven participants were in Australia, while 13 were overseas (North America and Europe) at the time of the study. 63.5% of participants held undergraduate or graduate degrees. Participants were recruited by convenience sampling via social networking and university websites. No payments were offered for participation. Participants completed the questionnaires via a web based survey application, ‘Survey Monkey’. The study was approved by the Ethics in Human Research Committee at Charles Sturt University.

Instruments and Procedure

Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996).

The present study measured participants’ temporal discounting rates using the Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996). The MCQ contains 27 dichotomous items (nine questions each concerning ‘small’ (e.g. $11), ‘medium’ (e.g. $20) and ‘large’ (e.g. $31) amounts of money) and a manualised procedure for the computation of discounting rates (Kirby, 2000). For each of the three amount sizes, the points at which participants cease to select the immediate reward in favour of a later, larger one provides an estimate of temporal discounting. Discounting parameters were estimated assuming the commonly used hyperbolic model:

\[
V = \frac{A}{1 + k'd} \quad (1) \quad \text{(Mazur, 1987)}
\]

Where \(V\) represents the discounted value of the reward \(A\), and \(d\) the units of delay (days). Solving for \(k\) provides a discounting rate in the unit interval, assuming
that values decrease with added delay (but see Van Der Pol & Cairns (2000) for an example of increasing values as a function of delay). The hyperbolic model is favoured over exponential utility discount functions due to its broad empirical support (Ainslie, 2002; Kirby & Santiesteban, 2003; Vuchinich & Simpson, 1998). Lower discounting rates imply lower impulsivity. The MCQ has demonstrated adequate temporal stability (Kirby, 2009) and convergent validity (Kirby & Finch, 2010). As this was a hypothetical online study, participants were presented with the following instructions:

For each of the 27 choices, please indicate which reward you would prefer: the smaller amount TODAY, or the larger amount after the specified delay. Please take the choices seriously, as if you were choosing for real amounts of money.

**Moral Foundations Questionnaire (MFQ31; Graham et al., 2009).**

Participants then completed the Moral Foundations Questionnaire (MFQ31; Graham et al., 2009). The instrument has two parts. The first presents 16 statements and asks participants to rate the extent to which they take each statement into account when deciding if an act or situation is right or wrong (e.g. ‘Whether someone was treated unfairly’). The subsequent 15 items ask participants to rate their level of agreement with statements regarding moral concerns (e.g. ‘It can never be right to kill a human being’). There is one ‘catch’ item (Astrology – item #2) designed to detect careless responding.

The five scales are temporally stable; test–retest Pearson correlations for each foundation score are .67 (Harm/Care), .67 (Fairness/Equity), .70 (In-group), .75 (Authority), and .84 for Purity (Koleva, Graham, Haidt, Iyer & Ditto, 2009). The scales also display adequate predictive validity for social attitudes one would expect to find in particular sections of the community (for instance, vegetarians score highly on ‘Harm/Care’). Participants mean scores on the ‘Binding’ foundations (Loyalty,
Authority & Purity) were subtracted from their mean scores on the ‘Individualising’ foundations (Fairness, Care) in order to determine their scores on the ‘Progressivism’ scale.

Zimbardo Time Perspective Inventory (ZTPI; Zimbardo & Boyd, 1999).

Scores for the 52 items on the ZTPI load onto five scales. ‘Future’ orientated respondents tend to endorse delaying gratification in pursuit of future rewards. Those who endorse ‘Present Hedonistic’ items place a large personal emphasis on enjoying pleasures in the moment, while the ‘Present Fatalistic’ scale measures the extent to which respondents believe their lives are determined by external forces. Higher endorsement of items in the ‘Past Positive’ scale indicates a nostalgic view of one’s past while endorsing ‘Past Negative’ scale items indicates a more rueful opinion of the past. The scales are internally consistent with Cronbach’s alpha coefficients of .77 (Future), .79 (Present Hedonistic), .74 (Present Fatalistic), .80 (Past Positive) and .82 (Past Negative) (Zimbardo & Boyd, 1999).

Self-Importance of Moral Identity (IMI; Aquino & Reed, 2002).

The Self Importance of Moral Identity Scale (IMI; Aquino & Reed, 2002) is a ten-item Likert scale, the scores for which load on two factors. Internalised Moral Identity (Cronbach’s $\alpha = .77$) reflects the extent to which the respondent believes that moral behaviour forms part of their identity, regardless of whether or not others are aware of it. Symbolised Moral Identity (Cronbach’s $\alpha = .76$) concerns the extent to which respondents believe they present to others as a moral person by virtue of their social affiliations and activities. The scales are well validated using self-report and behavioural observation (Aquino & Reed, 2002).
Results

In spite of studies indicating that web-based research is not prone to excessive response set (Austin, University, & John, 2004), Mahalanobis distance analysis identified a number of multivariate outliers, which on inspection indicated uniform and careless responding. This was most frequent for the temporal discounting measure, whereby participants always chose the large later reward over the small, earlier reward, rendering it impossible to calculate the indifference point. Since the intent of temporal discounting procedures is to determine this point, Critchfield and Kollins (2001) advise that such responses should be omitted from analyses. We followed this advice, leaving \( n = 170 \) participants (140 female), 65\% of whom held undergraduate degrees or higher.

Temporal discounting rates for the small, medium and large monetary amounts, as well as the geometric mean for all three, were calculated for each participant using the procedure described by Kirby (2000). Consistent with previous work (Curry et al., 2008; Mitchell, 1999; Ohmura, Takahashi, Kitamura, & Wehr, 2006) discounting data were skewed and kurtotic. Base log10 transformation normalised the distributions, rendering them suitable for parametric analyses.\(^5\)

Internal consistency coefficients for the MFQ31 were low, however the Cronbach’s alpha for the remaining scales were adequate to high. Consistent with the discounting literature, age effects were detected for the small \( (r_s(168) = -0.15, p = .024) \) and large monetary amounts \( (r_s(168) = -0.13, p = .046) \); older participants discounted less. Contrary to earlier studies of temporal discounting (Critchfield & Kollins, 2001; Federick, Loewenstein, & O'Donoghue, 2003; Green, Fry, & Myerson, 1994; Green et al., 1996) no association between observed discounting rates and education were detected.

\(^5\) Transformed discounting rates were used in all parametric analyses. For non-parametric analyses and descriptive purposes, pre-transformation figures are used.
Consistent with earlier work, magnitude effects were detected; small delayed amounts were discounted at a significantly higher rate ($M = .044$, $SEM = .004$) than the medium amounts ($M = .028$, $SEM = .003$; $t(168) = 7.85, p < .001, d = .60$). Medium amounts were discounted to a significantly greater degree than the large amounts ($M = .018$, $SEM = .003$; $t(168) = 9.482, p < .001, d = .73$).  

Bootstrapping analyses (Preacher & Hayes, 2004) of the model proposed in figure 1 indicated significant—but indirect—effects of temporal discounting rates on the Individualising moral foundations. Higher temporal discounting rates, via Importance of Moral Identity Scores (Internal) predicted lower scores on the Individualising foundations of Harm and Fairness, $z = -.045$, $SE = .024$ [$CI = -.105, -.010$] $p = .008$, and $z = -.034$, $SE = .020$ [$CI = -.088, -.005$] $p = .017$, respectively. Indirect effects were also detected for the Progressivism scale, $z = -.029$, $SE = .018$ [$CI = -.078, -.003$] $p = .027$. No such effects were detected for the Binding foundations.

Surprisingly, none of the moral foundations demonstrated a direct relationship to observed temporal discounting (TD) rates (Table 1). However, temporal discounting rates were inversely correlated with a Future time orientation and Importance of Moral Identity (Internal). Discounting rates were positively associated with a Present Fatalistic attitude toward time (Table 1). Bootstrapping analysis of the relationships between temporal discounting (TD) rates and Internal Importance of Moral Identity, with Future and Present Fatalistic time perspectives as potential mediators, determined that Present Fatalistic and Future time orientations made significant, unique contributions to the prediction of temporal discounting rates ($z = .247$, $SE = .086$ [$CI = .077, .410$] $p = .004$, and $z = -.233$, $SE = .086$ [$CI = -.408, -.072$] $p = .002$, respectively).  

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6Cohen’s $d$ for these paired sample $t$ tests was calculated using the formula suggested by Morris and deShon (2002) taking the interdependence of the means into account. A bonferroni adjustment was applied to the comparisons, resulting in $α = .05/3 = .017$.

710000 bootstrap samples, reporting bias corrected (BC), 95% confidence intervals (AMOS v19).
Analysis of the same model also revealed that temporal discounting (TD) rates and Present Fatalistic time perspectives inversely predicted scores on the Internal scale of the Self Importance of Moral Identity (IMI). Future time perspective positively predicted scores in the IMI (Internal Scale) (Table 1.). Bootstrap path analyses indicated that the indirect effects of TD rates on IMI (Internal Scale) scores, via Present Fatalistic and Future scales as mediators, were significant, $z = -.083$, $SE = .039$ [CI = -.179, -.026] $p = .001$. However, direct effects of TD rates on Internal IMI were not, $z = -.083$, [CI = -.227, .060] $p = .272$. Thus, scores on Future oriented attitudes to time, as well as present oriented fatalism (Present Fatalistic) mediated the correlation between TD rates and Internal IMI scale such that the TD rates were no longer a significant predictor of Internal Importance of Moral Identity.

Moral foundation scores did not bear any significant relationship with attitudes to time, with one exception. A nostalgic view of the past (‘Past Positive’) was positively associated with scores for ‘Loyalty’ (Table 1.)
Table 1. Spearman’s rho bivariate correlations between Temporal Discounting and the MFQ31, ZPI, and Self Importance of Moral Identity

<table>
<thead>
<tr>
<th>Scale</th>
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<th>12.</th>
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<td>MCQ 1. Discounting rate</td>
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<td>MFQ31 2. Care</td>
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<td>3. Fairness</td>
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<td>4. Loyalty</td>
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<td>5. Authority</td>
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<td>6. Purity</td>
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<td>7. Progressivism</td>
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<td>ZTPI 8. Past Pos.</td>
<td>.070</td>
<td>-.050</td>
<td>-.021</td>
<td>.171*</td>
<td>.110</td>
<td>.087</td>
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<td>9. Past Neg.</td>
<td>.048</td>
<td>.090</td>
<td>.088</td>
<td>.024</td>
<td>.068</td>
<td>.074</td>
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<td>10. Future</td>
<td>-.207**</td>
<td>.133</td>
<td>.106</td>
<td>.042</td>
<td>.076</td>
<td>.076</td>
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<td>11. Present Hed.</td>
<td>.119</td>
<td>.025</td>
<td>.042</td>
<td>.049</td>
<td>-.002</td>
<td>.041</td>
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<td>12. Present Fat.</td>
<td>.195**</td>
<td>.045</td>
<td>.026</td>
<td>.112</td>
<td>.090</td>
<td>.068</td>
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<td>Self Importance of Moral Identity 13. IMI - internal</td>
<td>-.175*</td>
<td>.243**</td>
<td>.195**</td>
<td>.014</td>
<td>.033</td>
<td>.052</td>
<td>.144</td>
<td>.053</td>
<td>-.066</td>
<td>.250**</td>
<td>.021</td>
<td>-.245**</td>
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<td>14. IMI - symbolised</td>
<td>-.079</td>
<td>.256**</td>
<td>.152*</td>
<td>.048</td>
<td>.038</td>
<td>.104</td>
<td>.097</td>
<td>-.094</td>
<td>.043</td>
<td>.205**</td>
<td>.090</td>
<td>-.072</td>
</tr>
</tbody>
</table>
Discussion

The aim of the present study was to investigate the relationships between moral foundations described by Moral Foundation Theory (Graham et al., 2011) and impulsivity, as measured by a hypothetical measure of temporal discounting rates. Moreover, it was proposed that relationships detected between temporal discounting rates and moral foundations would be mediated by respondents’ education, as well as the perceived importance of morality as part of one’s identity. The results did not indicate a direct relationship between temporal discounting rates obtained by the Monetary Choice Questionnaire (MCQ; Kirby & Marakovíc, 1996) and scores on the Moral Foundations Questionnaire (MFQ; Graham & Haidt, 2009).

Subjective time perspectives (ZTPI; Zimbardo & Boyd, 1999) were also included to determine whether temporal discounting (TD) rates, or attitudes toward time, were more closely associated to scores on the Moral Foundations Questionnaire. With the exception of ‘Past Positive’ and ‘Loyalty’, which showed a weak positive relationship, no other associations were detected.

Obtained TD rates were inversely associated with scores on the Internal Self Importance of Moral Identity Scale (IMI), indicating that the higher ones’ level of impulsivity, the lower the subjective importance of having a ‘moral’ identity. This accords with the first part of our predicted model (figure 1) that those with lower discounting rates would be better able suppress selfish impulses and behave according to whatever social rules they have internalised. Self-perception of these behaviours would lead to a self-concept that includes being a person who ‘does the right thing’. There were also significant, positive associations between the Importance of Moral Identity Scales and responses on the Moral Foundations Questionnaire, which accords with the second part of our proposed model, whereby the more one believes a moral rule is a necessary part of their identity, the more they are likely to endorse its general
importance. While the interpretation of indirect and mediation effects remains contentious, we agree with Mathieu and Taylor (2006) and Preacher and Hayes (2004) that the two are not equivalent. In the absence of a significant total effect between discounting rates and scores on the Moral Foundations Questionnaire, there is nothing to ‘mediate’ (Mathieu & Taylor, 2006, p. 1038). What is demonstrated in the present work is an indirect effect, not a partial or full mediation as hypothesised. Thus, we do not conclude that the results support our proposed model.

Curiously, links between Importance of Moral Identity and the Moral Foundations subscales were significant for the Individualising foundations (Care & Fairness), but not the Binding foundations. It is interesting then that the subscale ‘Progressivism’ did not evidence a significant relationship with the Importance of Moral Identity scales. Nevertheless, these results present more evidence for the fractionation of moral concerns into those that centre on the Individual versus those that place the Community as the locus of moral obligation.

But why should those who endorse fairness and care be more likely to regard morality as a greater part of their self-concept than those who endorse the Binding foundations? The answer may be artefactual. The instructions for the Self Importance of Moral Identity Scale require respondents to imagine a person who is ‘Caring, Compassionate, Fair, Friendly, Generous, Helpful, Hardworking, Honest, and Kind’ (Aquino & Reed, 2002). As Haidt and Graham (2006) rightly point out, social scientists have generally tended to crown their liberal world-view as the general definition for moral characteristics. The attributes described above clearly align with the Individualising foundations, but it is less clear how they might accord with the Binding foundations. If respondents were required to imagine someone who is ‘Loyal, Respectful, Patriotic, Hygienic and Religious’, it seems reasonable to expect that those who endorse the Binding foundations would also score highly on such a variation of the
Self Importance of Moral Identity Scale. Future studies may attempt to validate such variations. Broadening the instruments available to researchers, allowing them to investigate moral concerns that have hitherto appeared amoral to many social scientists (Haidt & Graham, 2006) would be a welcome development in the field of moral psychology.

In line with previous research on the temporal perspectives, a future oriented attitude was associated with temporal discounting (TD) rates; such that higher impulsivity predicted a lower concern for the future. As may be expected, Present-Fatalistic time perspective positively predicted higher levels of impulsivity – given that items in that scale endorse ‘living for the present’, as the future is beyond one’s control. The Future and Present Fatalistic scales were unique predictors of discounting rates and mediated the effect of TD rates on the Internal Importance of Moral Identity. Thus, the TD rates obtained with the Monetary Choice Questionnaire did not bring anything to light that was not demonstrated by the self-reported time perspectives found in Zimbardo’s Time Perspective Inventory (ZTPI).

While our proposed model was not supported, one of the more interesting aspects of the present results was that participants’ attitude to the future, and beliefs about agency in their lives, are predicted by the subjective importance of having a moral identity. For example, the more one believes that they have some agency over their lives (described by a low score on the Present Fatalistic scale), the more one appears to regard having a moral identity as important. This result suggests the philosophical idea that moral obligation (‘ought’) can only apply where it is clear that genuine decisions (‘can’) are possible may also be a common feature of folk-philosophy (Chrisman, 2012).

It is perhaps unsurprising that a future oriented view of time was positively associated with importance of having a moral identity. Concern for the future (future
generations in particular) has a strong moral connotation (Bohm & Pfister, 2005). Speculation on the causal direction of this association is not possible with the present result. However, it is possible that a desire to appear moral may induce participants to endorse items that indicate a preference for completing obligations before taking part in leisure pursuits, or showing restraint in the service of future goals. This explanation certainly points toward a relationship between time and morality. However, the role of actual decisions and behaviours with regard to delayed rewards remains inconclusive.

In light of Kirby and Finch (2010) as well as Miller et al.’s (2004) findings that discounting rates load on self-report factors, which include hedonistic and pleasure seeking items, it is surprising that the correlation coefficient between the ZTPI Present Hedonistic scale and temporal discounting rates fell short of significance. Nonetheless, the relationship between the Future and Present Fatalistic Scales and obtained TD rates leads us to suspect that participants’ responses to the monetary choices may have been influenced by their attitudes to time, which may not reflect what they would actually do when presented with decisions about real money. The difference may not be trivial.

While numerous studies have found no differences between temporal discounting measurement methods in terms of the absolute discounting rates (Johnson & Bickel, 2002), differences as a function of whether the decisions involved real payoffs have been observed when assessing correlations between discounting rates and other variables of interest. Shamosh and Gray (2007) observed that the association between discounting and intelligence quotient differed depending on whether the decisions were always hypothetical, real, or whether pay-off was a matter of chance. Similarly, while a number of studies have concluded that discounting rates do not differ according to the procedure used to measure them (Green, Myerson, Shah, Estle, & Holt, 2007), Epstein and colleagues (2003) found systematic and significant differences between their computerised and pencil and paper based discounting tasks. The role of temporal
discounting, self-concept, and possibly education in the formation of moral attitudes may be further illuminated by the use of genuine decisions about delayed monies, as well as alternative means of estimating temporal discounting rates.

This seems a worthwhile endeavour if this and subsequent works can contribute to understanding how individuals develop and maintain their moral world-view. As Haidt and Graham (2006) point out, no effort that assists ‘liberal’ minded and ‘conservative’ groups to understand one another as genuinely moral agents is likely to be wasted.
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Chapter 3

Delay Discounting Rates are Temporally Stable in an Equivalent Present Value Procedure Using Theoretical and ‘Area under the Curve’ Analyses.

This chapter has been published in The Psychological Record.

Abstract

Temporal discounting rates have become increasingly popular as a dependent variable in social science research. While choice procedures are commonly employed in the measurement of discounting rates, equivalent present value (EPV) procedures may be superior in terms of sensitivity to experimental manipulation. While their validity has been established, their use has been impeded by the absence of test-retest reliability data. Staff and students at a regional Australian university \((n = 53)\) attended two sessions separated by two weeks, during which they took part in a matching temporal discounting procedure. Participants completed 30 one shot, second price auctions for two amounts \($9.90 & $29.90\), with delays ranging from 1 – 43 days. While the data were better described by a hyperbolic than exponential model, discounting rates were also assessed using atheoretical ‘Area Under the Curve’ analysis. Congruent with results obtained using choice procedures, effects for reward magnitude, age and education were detected on both testing occasions. Test-retest (relative) stability of the EPV procedure compared favourably with choice procedures \((r = .75)\). Where discounting rates are used as a dependent variable, brief EPV procedures combined with atheoretical analyses of discounting rates offer the most sensitive means to detect subtle experimental effects.
Delay Discounting Rates are Temporally Stable in a Matching Procedure Using Theoretical and ‘Area Under the Curve’ Analyses.

As a rule, when one wants something (like a new bicycle or a cigarette), they prefer to get it sooner than later, while for aversive events like dental procedures one is less concerned when the event is still four weeks distant than right before the appointment. The finding that the subjective value\(^8\) of future outcomes reduces in inverse proportion to the delay until the event occurs (Kirby, 1997) is referred to as delay or temporal discounting. This effect is most frequently described by exponential or hyperbolic models (Critchfield & Kollins, 2001; Kirby, 2006; Schweighofer et al., 2006).

**Hyperbolic and Exponential Discounting**

Expected utility theory requires that an organism will tend toward behaviours that maximise expected gains for effort expended (von Neumann & Morgenstern, 1953). For discounting theory this led to the assumption by economic theorists that human discounting rates are exponential (Bickel & Johnson, 2003):

\[
V = Ae^{-kD}
\]

(Kirby, 1997, p. 54)

Here \(V\) represents the discounted value of the reward \(A\), and \(D\) represents units of delay. Solving for the free parameter ‘\(k\)’ provides the discounting rate for a single trial (values in the unit interval, assuming values necessarily decrease as a function of delay, but see van Der Pol & Cairns (2000) for an exception). Exponential discounting applies a fixed rate of discounting per unit of delay, predicting stable long term preferences. For example, if an individual prefers 25 dollars in 92 days over 20 dollars

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\(^8\) The term ‘value’ as used in the temporal discounting literature does not refer to ‘attractiveness’ of an outcome as it does in the colloquial sense. Rather, ‘value’ describes the extent to which the outcome is salient, or the emotive force the outcome has for the decision-maker. Thus, the value of an aversive outcome increases as it becomes more aversive.
in 90 days, she should still prefer 25 dollars when there are only two days left to wait, rather than changing her preference and taking the 20 dollars without further delay (Ainslie, 2002; 2009; Thaler, 1981). While the exponential model cannot account for such commonly observed reversals of preference (Green, Myerson, & McFadden, 1997), the hyperbolic model in equation two (below) does (Ainslie, 2001, 2002):

$$V = \frac{A}{1 + (k \times D)}$$

Mazur (1987)

While individual discounting rates are highly variable (Frederick, Loewenstein & O'Donoghue, 2003, p. 14), observations of discounting rates in humans demonstrate, *inter alia*, inverse relationships with age (Green, Fry, & Myerson, 1994; Green, Myerson, Lichtman, Rosen, & Fry, 1996), education (Green et al., 1994; Green et al., 1996; Reimers, Maylor, Stewart, & Chater, 2009), and reward size (Green & Myerson, 1997; Kirby & Marakovic, 1996). Increasing scientific interest in temporal discounting rates has generated a need for reliable and sensitive measures. Below we describe two common methods.

**Choice Procedures Versus Equivalent Present Value (EPV)**

Temporal discounting rates are normally estimated using either a choice or equivalent present value (EPV) procedure (Loewenstein and Prelec, 1992, p. 576). Choice procedures involve participants having to choose between a small, early reward and a larger, later reward (e.g., 'Would you prefer $55 now or $75 in 19 days?'). Amounts and/or delays are adjusted on each trial. The point at which participants

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9 Green, Myerson and McFadden (1997) argued that if discounting rates were dependent on amount of reward, an exponential model could potentially account for preference reversals. However, preference reversals are observed in animals (Green & Myerson, 1997; Rachlin & Green, 1972) whereas 'amount dependent' discounting rates (the so-called ‘magnitude effect’) have not been detected in animals (Grace, 1999; Ong & White, 2004). Thus, the hyperbolic model may be regarded as the more parsimonious of the two.

10 ‘Equivalent present value’ procedures are elsewhere referred to as ‘matching procedures’ (Read & Roelofsma, 2002, p.140). However, to avoid confusion with procedures concerning Herrnstein’s matching law we adopt Loewenstein & Prelec’s (2002, p. 576) term.
switch from the small, early to the larger, delayed reward provides an estimate of the temporal discounting rate. This method has been used to infer rates of discounting for health programs (Chapman & Elstein, 1995), environmental gains/losses (Hardisty & Weber, 2009), and money (Kirby, 2009; Whelan & McHugh, 2009).

The widely used ‘Monetary Choice Questionnaire’ (MCQ; Kirby & Marakovic, 1996), contains 27 dichotomous items (nine questions each concerning ‘small’, ‘medium’ and ‘large’ amounts of money) and a manualised procedure for the computation of discounting rates (Kirby, 2000; Wileyto, 2004). For each of the three amount sizes, the points at which participants cease to select the immediate reward in favour of the later, larger one provides an approximation of the individual’s temporal discounting rate (solving for ‘k’ in equation 2). The MCQ has allowed non-specialists to compute temporal discounting rates with relative ease. Another advantage of a standardized procedure for computing discounting rates is ease of comparison between studies.

Equivalent present value (EPV) procedures, on the other hand, require participants to nominate a present value that is subjectively equal to the delayed amount less what the specified delay is worth to them (e.g., ‘How much money would you be prepared to pay now to receive $29 in 15 days?’). These procedures do not restrict participants to forced choices between pre-determined values. However, EPV procedures are less convenient to administer than choice procedures. The necessary instructions may require the sustained concentration of participants, resulting in some variability in the ‘orderliness’ of responses. Nevertheless, there are circumstances under which the EPV procedure is preferable to the choice procedure. Where researchers are interested in comparing the fit of theoretical models (e.g., hyperbolic versus exponential), a number of ‘indifference points’ are required to provide discounting curves over a number of delays. The 27 items in the MCQ yield a single
approximation of one’s discounting rate, whereas every item in an EPV procedure represents an indifference point. Using such a procedure Kirby, Winston and Santiesteban (2005) and Kirby and Santiesteban (2003) obtained 30 indifference points per participant (15 each in relation to two delayed amounts [i.e. $9.90 and $29.90]), sufficient to allow estimates of fit that are able to distinguish between theoretical models and provide a more accurate estimate. Choice procedures require many more items to yield the same data, and in doing so cede the advantage of brevity to EPV procedures.

Kirby and Santiesteban’s (2003) study was also unusual in that it is one of very few studies that required participants to commit their own money. This is an important methodological feature as decisions concerning delayed consequences are influenced by the manner in which they are presented (Highhouse, Mohamme and Hoffman, 2002). For example, gains tend to be discounted more steeply than losses (Kahnemann & Tversky; 1979; LeBoeuf, 2006; Loewenstein & Prelec, 2002; Read, Frederick, Orsel, & Rahman, 2005). Bidding with money that has been personally budgeted elsewhere may be perceived as a greater opportunity cost (a loss) than bidding the same amount with hypothetical funds or with a stake provided by the experimenter (a gain), possibly improving the ecological validity of the results where consumer behaviour is concerned. Kirby and Santiesteban’s (2003) method is therefore employed in the present study.

Choice procedures may also be subject to ceiling effects. For example, the MCQ questionnaire allows for the estimation of discounting rates in the range .00016 - .25. As delay discounting varies dramatically between individuals, limiting reportable discounting rates may omit participants with higher or lower rates of discounting. In a recent hypothetical study Harrison and McKay (2010, Chapter 2) used the MCQ to infer discounting rates for 200 participants, finding that more than ten percent of
respondents reported discounting rates of .25. No other single discounting rate was reported by so many participants, thus it is likely that the discounting rate of the sample was distorted by ceiling effects.

Brief choice procedures like the MCQ have made it convenient to measure temporal discounting rates with no participant training or supervision; they are particularly well suited to online studies or studies with very large numbers of participants. This is a beneficial development for the study of this important variable where a single approximation of discounting rates is required from large groups.

However, for experimental studies, participants are often relatively few in number. Moreover, researchers may be concerned with detecting what may be very subtle effects on temporal discounting. In these cases, brief EPV procedures, such as the paper and pencil task employed by Chapman (1996) are preferable because in a brief instrument (for example, 25-35 items) they provide finer grained estimates of discounting rates, allowing the detection of subtle changes to individual discounting rates, as well as the requisite indifference points to facilitate the comparison of theoretical models where desired. The fact that EPV procedures require more instruction and supervision is not necessarily an impediment in the experimental context as they most frequently take place in a supervised setting where additional tasks are being performed.

Even where model fitting is not required, estimation of discounting rates using theoretical models may not be the most appropriate method in the experimental context. While hyperbolic models consistently fit discounting data better than exponential models, this is a relative finding; frequently hyperbolic models represent the best of two poorly fit models, such that some participants’ data must be omitted (Ohmura, Takahashi, Kitamura, & Wehr, 2006), or the simple hyperbolic equation must be altered, raising the denominator to a power to improve the fit (Critchfield & Kollins,
The ubiquitous equation-type dependent error introduces 'noise' in the calculation of discounting rates; problematic when trying to detect subtle experimental effects on discounting rates. In addition, estimates of model parameters are usually skewed and kurtotic, making them inappropriate for parametric analyses without transformation (Keene, 1995). This reduction in sensitivity and increased difficulty of analysis is unnecessary. With sufficient indifference points one may compute discounting rates atheoretically by calculating the 'Area Under the Curve' (AUC; Myerson et al., 2001). AUC analyses do not rely on estimates of model parameters, eliminating equation-type dependent error. For researchers interested in a sensitive measure of discounting rates which is amenable to parametric analysis, Area Under the Curve analysis (AUC) is a helpful technique. Brief EPV procedures are able to provide the necessary data while choice procedures of comparable length cannot.

The temporal stability of delay discounting rates measured using choice procedures has been established. However, the stability of equivalent present value (EPV) procedures has not. Simpson and Vuchinich (2000) reported one week test-retest coefficients ($n = 15$) of $.90$ for a hypothetical choice procedure. Baker, Johnson and Bickel (2003) and Johnson, Bickel and Baker (2007) used an EPV-style questionnaire to obtain subjective equivalence estimates between monetary rewards, periods of health improvement and nicotine. Equivalencies obtained in the pilot phases of these studies were subsequently used in choice procedures administered in two sessions, one week apart. Discounting for money, health gains/losses and nicotine gains/losses were assessed. Test-retest data for these studies ranged from $.71 -.90$ and $.55 -.90$ respectively. Most recently, Reed and Martens (2011) presented elementary school students with hypothetical choices between small immediate and larger delayed monetary amounts, reporting a one week test retest reliability coefficient of $.88$ (p. 10).
The obtained discounting rates were also found to predict student behavioural change in response to immediate versus delayed rewards in the classroom, a helpful addition to the literature supporting the ecological validity of temporal discounting rate estimates.

Longer periods between test-retest sessions produce lower reliability estimates. Beck and Triplett (2009) obtained a particularly large sample ($n = 299$) of undergraduate students for a pencil and paper based procedure whereby participants were required to choose the present value of a delayed, hypothetical amount of money from a supplied list. Six week test-retest coefficients of .64 for hyperbolic model based estimates, and .70 for Area Under the Curve (AUC) estimates were observed.

Similarly, Ohmura et al. (2006) used a hypothetical choice procedure to collect three-month test-retest data with 22 undergraduates who were presented with an immediate reward, and a set delay period (i.e. 7 days). The authors reported test-retest correlations of .61, assuming a hyperbolic model. Using the Monetary Choice Questionnaire, Kirby (2009) reported test-retest coefficients of .71 at one year ($n = 56$). These stability estimates therefore account for approximately half of the observed variance in temporal discounting rates between individuals; comparable to some measures of personality (Kirby, 2009). However, rates of temporal discounting would be of little use as a dependent variable if they were impervious to context. As it happens, temporal discounting rates appear to be sensitive to sign (gains versus loss), working memory load, social context (e.g. gambling environment), size of the reward, and relative states of deprivation (Odum & Baumann, 2010). However, while a group of participants may display higher discounting rates for food when they are hungry, it is equally likely that the group would broadly retain their ‘pre-deprivation’ rank order (Odum & Baumann, 2010, p. 41). As such, the high relative stability of discounting rates does not preclude the impact of situational influences or negate its utility as a dependent variable.
Notwithstanding, Kirby (2009) suggested that although situational contexts do affect discounting rates, the particularly high stability rates obtained by Baker et al. (2003), Bickel et al. (2007), Simpson and Vuchinich (2000) and (one may presume) Reed and Martens (2011), may have been inflated by participants being able to recall their previous selections after one week. Kirby (2009) argued that longer intervals should control for memory effects. However, this may be difficult for repeated measures research designs where discounting rates are a dependent variable. Longer intervals not only increase logistical difficulties and the cost of experimental studies, they increase the potential effects of confounding variables (e.g. changes in financial situation) on temporal discounting rates during the interval. Experimental manipulations of discounting rates necessarily require as short an interval as possible. Therefore, memory effects need to be controlled using methodological processes. Memory effects could be exacerbated by an artifact of the choice procedures used in these studies, which provide participants with two-option, forced choice items. At retest participants are presented with the option they chose earlier. This method lends itself to recognition, which in most contexts is easier than free or even cued recall (Perlmutter, 1979). Brief choice procedures such as the MCQ would be particularly prone to recognition memory effects. Equivalent present value (EPV) procedures provide cues (via presentation of the delay period and amount) to recall, but do not present the participants’ actual responses, making memory effects less likely at retesting. While the present study also employs a short test-retest interval (two weeks), it was expected that memory effect would be controlled by the methodology employed. Thus, the resultant reliability coefficients would be more congruent with studies that employed a retest interval of six weeks (Beck & Triplett, 2009) or greater than studies that used a retest interval of two weeks or less (Simpson & Vuchinich, 2000).
Baker et al.’s (2003) pilot studies notwithstanding, there is no published data, as far as we are aware, on the temporal stability of EPV procedures. Such data is overdue since the technique has been in use for some time. For example, Chapman (1996) used a 32 item ‘fill in the blank’ EPV procedure to measure discounting rates for money and health outcomes; the study’s finding that discounting is likely to be domain specific could only be strengthened by test-retest reliability data for either domain. Given that choice and EPV procedures produce different total rates of discounting, as well as different discounting ‘curves’ as a function of successive delays (Ahlbrecht & Weber, 1997; Read & Roelofsma, 2003), the temporal stability of EPV procedures cannot be taken for granted. Moreover, demonstrating the stability of individual discounting using an EPV procedure would rule out the potential ceiling and recognition memory effects inherent in choice procedures, lending support to earlier findings that delay discounting rates are relatively stable (Critchfield & Kollins, 2001; Kirby, 2009).

The lack of test-retest reliability data for EPV procedures is an impediment to their widespread use, especially for experimental paradigms where sensitivity of the measure may mean the difference between detecting an effect and a type II error. The present study sought to address this gap in the literature and provide test-retest reliability for an EPV procedure used by Kirby and Santiesteban (2005); the method employs a second price auction where participants are required to bid on delayed sums of money such that they would ‘break even’. Vickrey (1961) second price auctions are designed such that it is in participants’ interest to bid exactly what the delayed money is worth to them. Thus each bid provides an equivalent present value (EPV). Fifteen such indifference points each are obtained for a large, and a small amount of money. Obtained data were fitted to exponential and hyperbolic discounting models for comparison to the extant literature.
It was predicted that discounting rates obtained in the present study would demonstrate inverse relationships with age, education and reward magnitude, replicating common findings (Kirby & Santiesteban, 2005) and contributing to the evidence base for the validity of this brief EPV procedure. Moreover, to avoid equation type-dependent systematic error, rates of discounting for delayed rewards were quantified in an ‘atheoretical’ procedure; computing the Area Under a normalized matching Curve (AUC) as suggested by Myerson, Green, and Warusawitharana (2001).

Method

Participants

Participants were 67 staff members and students (53 females; Mean age = 28.75, SD = 12.73) at two campuses of a regional Australian university. Forty four participants had completed secondary school only; eight also held undergraduate degrees and fifteen had completed post-graduate qualifications. Fifty three participants (42 females; Mean age = 28.53, SD = 12.36) returned for the second session. Participants were recruited via the university email and research participation system. All participants were paid AUD$10.00 for participation in both sessions while psychology students also received course credit.

Procedure

Sessions one and two were conducted two weeks apart, in groups of between three and eight participants. Prior to the first session participants were contacted by email and informed that they were required to bring AUD$30.00 with them in order to bid in a series of auctions. No volunteer declined to participate as a result of this requirement. In a series of 30 ‘one shot’ Second Price auctions, participants were asked to nominate an amount they were prepared to pay for delayed sums of money such that they believed they would just ‘break even’ (Vickrey, 1961). The auctions were preceded by a brief training session and three practice auctions during which
participants had the opportunity to ask questions. Two amounts of money were presented (AUD$9.90 & $29.90), with the amount alternating on each trial. Fifteen delays (of 1, 2, 3, 4, 5, 7, 11, 15, 19, 23, 27, 31, 35, 39 and 43 days) were presented for each amount in randomised order such that there was no correlation between delay amount and the order of the auctions.

After entering a bid, participants were directed to a second screen where they were asked whether they would like to ‘keep their money’, ‘wait for the delayed money’ or whether those options ‘feel about the same to me’. This measure is designed to reinforce the instruction that participants should bid to ‘break even’ and provides an opportunity to fine tune their bid, raising the accuracy of obtained indifference points (Kirby & Santiesteban, 2003). If the ‘keep money’ option was selected, the participant was instructed to adjust their bid downwards, if they selected the ‘wait’ option they were instructed to raise their bid (by $0.10 increments). This process could be repeated until the participant selected the ‘feel about the same’ option, at which point their final bid was submitted.

At the conclusion of the auctions, a number between 1 and 30 was selected at random, determining which auction was the ‘real’ auction. The highest bidder was invited to complete the transaction by paying the amount placed by the second highest bidder (Vickrey, 1961). To control transaction costs regardless of delay time, the full amount was received by presenting the receipt at the Psychology School office once the nominated time delay (1 – 43 days) had elapsed. Participants were paid AUD$10.00 for attending the second session11.

11 Participants were also taking part to provide data for a supraliminal priming study. To this end, participants completed a 20 item sentence unscrambling task before completing the auctions in the first, but not the second, session. Cox (2005) attempted to manipulate temporal discounting rates using a similar text editing task, and found that the task had no detectable effect. In any case, any impact in this research context would make retest estimates more conservative rather than inflating them.
Materials

Participants completed all trials on IBM computers. The auctions were run on a web-based instrument created using the Dreamweaver application. Auction data was collated using the Microsoft Access database application.

Results

Bidding data were analyzed separately for all participants to avoid artefactual biases introduced by drawing parameter estimates from aggregate data (Kirby, 1997). Discounting rates were calculated separately for the smaller ($9.90) and larger ($29.90) amounts, before taking the geometric mean of both (total) as an estimate of discounting for each participant. Discounting estimates (‘k’) and goodness of fit measures against hyperbolic and exponential models were estimated using iterative non-linear regression.

We used root mean square error (RMSE), expressed as a proportion of the total un-delayed reward amounts (9.90 & 29.90) as an index of the equation’s ‘goodness of fit’; lower RMSE scores indicate smaller error terms, and therefore a better model fit. Discounting rates were also estimated theoretically by measuring ‘Area Under the Curve’ (AUC) using the trapezoid summation method based on equation 3 below.

\[
\sum(x_2 - x_1) [(y_2 + y_1)/2]
\]

(Myerson et al., 2001, p. 240).

These estimates of individual discounting rates do not include the residual error (RMSE) inherent in model-based iterations.

Consistent with previous work, theoretical ‘k’ parameter estimates for the model equations were skewed and kurtotic, while AUC estimates did not violate the assumptions required for parametric analysis. Aggregated root mean squared error (RMSE) coefficients for hyperbolic discounting were significantly lower than those for
the exponential equation (Table 1). This was also the case for individual repeated measure comparisons of the hyperbolic and exponential equation, as demonstrated by the frequencies reported in the right column of Table 1. The hyperbolic estimates produced a superior fit over the exponential equation.

Table 1

*Means, Standard Errors, t Coefficients and Individual Comparisons of Root Mean Squared Error (RMSE) Coefficients for Hyperbolic and Exponential Models.*

<table>
<thead>
<tr>
<th></th>
<th>Hyperbolic model</th>
<th>Exponential model</th>
<th>t</th>
<th>sig</th>
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<td>SE</td>
<td>M</td>
<td>SE</td>
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Parametric (Pearson) and non-parametric (Spearman) correlation analyses were performed with untransformed equation parameter (k) estimate data. The k estimate data were then subjected to log10 transformation and parametric correlations were performed again. The log10 correlation coefficients were very similar to the non-parametric results while parametric analysis of the untransformed data produced much higher correlations. We assume that the latter were artificially inflated and therefore do not report them. For the model based estimates, nonparametric coefficients along with the untransformed data are presented, while parametric correlations are presented for the AUC analyses (Table 2).

As ‘Area Under the Curve’ (AUC) analyses introduces the least amount of error and are suitable for parametric analyses without further manipulation, analyses using AUC are presented below. Consistent with previous work, correlations between
patience and age \((r (51) = .41, p = .002)\), and education \((r (51) = .40, p = .003)\) were detected at both sessions. Reward magnitude effects were also detected, with the larger reward discounted significantly less than the smaller amount at time one \([t (51) = 8.90, p < .001]\) and time two \([t (65) = 9.40, p < .001]\).

Table 2

<table>
<thead>
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<th></th>
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<th>Time two (n = 53)</th>
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<th>r (total)</th>
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<td>.383</td>
<td>.030</td>
<td>.506</td>
<td>.031</td>
</tr>
</tbody>
</table>

** p < .001

Test-retest correlations differed for analysis type, with the highest correlation resulting from AUC analyses \(r_{\text{total}}(51) = .75, p < .001, r_{9.90}(51) = .70, p < .001\) and \(r_{29.90}(51) = .72, p < .001\). The difference is presumably a result of the fact that 'Area Under the Curve' analysis does not include equation-type dependent error. Similar effects were noted by Ohmura et al. (2006). Temporal discounting rates are highly variable between participants, meaning a few extreme cases could influence the analyses. However, Cook's \(D\) values for all cases were below 0.20. Therefore it is unlikely that the observed correlations are the result of any individual cases producing excessive influence on the data (Belsley, Kuh, & Welsch, 1980; Muller & Mok, 1977).

---

\(^{12}\text{Area Under the Curve supplies a 'patience' estimate in that the greater the area under the curve, the lower the participant's discounting rate. Therefore positive correlations between AUC estimates and demographic variables should be interpreted as representing an inverse relationship with discounting rates.}\)
Discussion

Differences in the temporal discounting estimates produced by choice versus equivalent present value (EPV) procedures have meant that in the absence of test-retest data for the latter, the stability of EPV procedures could not be assumed to match that of choice procedures. This has represented an impediment to their use; regrettable since temporal discounting rates are of increasing interest as a dependent variable in experimental research (Benjamin, Choi, & Fisher, 2010; Cox, 2005; Wilson & Daly, 2003), necessitating the most sensitive methods of measurement and analysis. The present study begins to address this gap in the literature by demonstrating that an EPV procedure used in a number of empirical works (Kirby & Marakovic, 1996; Kirby & Santiesteban, 2003; Kirby, Winston, & Santiesteban, 2005) is temporally stable. The test-retest coefficients obtained are comparable to those obtained with studies using retest intervals of six weeks or greater, such as Beck and Triplett (2009), Kirby (2009), and Ohmura et al. (2006). However, they are lower than Baker et al. (2003), Johnson et al. (2007), Reed and Martens (2011), and Simpson and Vuchinich (2000); these studies employing a retest interval of less than two weeks.

The finding that the present test-retest reliability coefficients are lower than those obtained for choice procedures tested using intervals of less than two weeks (Baker et al., 2003; Johnson et al., 2007; Simpson & Vuchinich, 2000) lends support to Kirby’s suggestion that the very high retest correlations (up to $r = .91$) obtained by these studies may be the result of recognition memory effects. It is reasonable to suggest that briefer choice instruments (like the Monetary Choice Questionnaire) would be even more susceptible to recognition memory effects. The retest period in the present study was also quite short (two weeks), however it was expected that, since recognition memory is not possible in this procedure, memory effects may be controlled for methodologically. The lower retest coefficients observed in the present
study could be interpreted as a more conservative estimate of the stability of discounting rates, and encouraging evidence that EPV procedures are preferable over very short retest periods, such as repeated measures experimental designs where discounting is a dependent variable. An even more direct test of this would be achieved by replicating the present study using brief choice and EPV procedures in a between subjects manipulation over a one week retest interval.

In addition to being the only study, as far as we are aware, to examine the test-retest stability of delay discounting rates using an EPV procedure, the present study is also one of few studies to examine temporal discounting rates using decisions concerning the participants’ own money (Kirby & Santiesteban, 2003; Kirby et al., 2005). The majority of discounting studies use either hypothetical measures (Simpson & Vuchinich, 2000) or provide the participant with a ‘stake’ (Curry, Price, & Price, 2008; Kirby, 2009). As discussed in the introduction, the prospect of committing one’s own money for up to 43 days presents a more vivid opportunity cost, as it is more likely that the participants’ money was already budgeted (formally or otherwise) toward a personally salient goal. Opportunity cost is an important issue for decision-making (Baker, Johnson & Bickel, 2003), thus it might be argued that the inclusion of such an aspect increases the ecological validity of the observations.

The present study is also congruent with previous work in that Area Under the Curve analysis (AUC) produced higher reliability estimates than model parameter estimates (Beck & Triplett, 2009; Ohmura et al., 2006). Such consistent results across studies are encouraging evidence that AUC analysis is as reliable as conventional model fitting. In addition it is much less likely to require data transformation and, as it eliminates systematic equation-type dependent error, may be more sensitive to experimental effects. Thus, researchers have cause to argue that in rare cases where significant changes to discounting rates are not detected by model fitting, but are
detected by AUC analysis (as suggested by Beck & Triplett, 2009, p. 354), accepting the AUC analysis is justified.

While temporal discounting rates appear to demonstrate similar levels of stability to some personality constructs (Kirby, 2009), they are not impervious to external influence (Odum & Baumann, 2010; Wilson & Daly, 2003). This raises a limitation of the present study. The first session took place during the teaching session at the university, while the second session took place during a mid-semester break. This period may have been associated with greater spending for the holidays or the opportunity to commit more hours to paid work. Ohmura et al., (2006) described a similar situation. As income and financial security are known to affect temporal discounting rates (Green et al., 1996; Ostaszewski, Green, & Myerson, 1998) the test-retest coefficients observed in the present study may be conservative. However, Kirby (2009) obtained discounting rates of .71 over a fifty-seven week delay, during which period one might presume that financial and social situations of participants could change to a greater extent. Stability of this order accounts for approximately half the observed variability in discounting rates. It may be that this represents the more stable proportion of temporal discounting rates, while the remaining variability observed at any given time may be better accounted for by situational variables and influences (see Odum & Baumann, 2010, for a review of state versus trait influences on discounting rates).

A second limitation of the study concerns the relatively short delays (maximum 43 days) compared to other studies (Beck & Triplett, 2009 for example, measured delays up to 5 years). While this limitation was a necessary logistical restraint as participants were asked to wait for their own funds to be returned, it does mean that the stability of this brief measure has been established only where short delays are concerned. Caution therefore should be exercised in generalizing these
results to longer term discounting, especially when using AUC analysis as longer delay interval (e.g. one to five years compared to three to six months) would have a disproportionate impact on the area under the curve.

It is also possible that participants with higher temporal discounting rates were less likely to return for the second testing session, meaning that the study takes account of the stability of participants with relatively low discounting rates. However, such self-selection may be ruled out, as observed discounting rates did not differ between those who participated in the first session only and those who participated in both.

The present study is a useful addition to the literature. The brief EPV procedure under investigation compares favourably with brief choice procedures in terms of relative (test-retest) stability. The detection of age, education and reward size effects also lends confidence with regard to the convergent validity of the measure with choice procedures.

Moreover, brief EPV procedures such as those used in the present study (or Chapman, 1996) may avoid the problem of recognition memory and ceiling effects, making them a more sensitive measure for use in repeated measures experimental designs than brief choice procedures. While brief choice procedures like the MCQ are extremely valuable for their ease of administration and scoring, experimenters measuring the effects of independent variables on discounting rates would do well to consider brief EPV procedures combined with Area Under the Curve (AUC) analyses.

Moreover, it has become increasingly clear that discounting is not domain general (Odum & Baumann, 2010). Individuals may have discounting rates for cigarettes (Baker et al., 2003; Mitchell, 1999; Odum, Madden & Bickel, 2002), good health (Chapman, 1996) or environmental outcomes (Hardisty & Weber, 2009) that differ from those for money. Ideally, any technique for measuring discounting rates should be modifiable such that these differing domains can be studied. For example,
one might use Vickrey auctions to have participants (hypothetically) bid present inconvenience for future convenience as a means to determine a community’s tolerance for civil engineering works (e.g. ‘In order to have a new bypass in my local area that would reduce travel time by 20 minutes, I am prepared to take a detour which would make my commute 40 minutes longer for ‘XX’ days’).

Temporal discounting is a rapidly growing area of psychological research (Madden & Bickel, 2010). The exciting creativity that accompanies such fertile research interests should be complemented by rigorous psychometric study of the means used to measure it. To this end, these results mitigate an obstacle to the use of EPV procedures, increasing the methodological options available to researchers interested in this important behavioural variable.
References


Chapter 4

Education Mediates the Relationship Between Temporal Discounting Rates
and Communal, but not Individual, Moral Foundations.

The study described in this chapter is presently under review at The Journal of Moral Education.
Abstract

Recent arguments for research into moral psychology to include collective and sacred moral intuitions, in addition to concerns about fairness and empathy, have produced relatively few studies in answer. Furthering this line of research, we examined temporal discounting and its relationship with Moral Foundations Theory, predicting that impulsivity would be inversely associated with the strength of moral attitudes. Education is a well-described correlate of liberal attitudes and impulsivity; thus it was predicted education would mediate relationships between temporal discounting and the Individualising (e.g. equality), but not Binding (e.g. loyalty) foundations. It was also predicted that participants’ sense of moral identity would mediate both. Fifty-three participants took part in 30 ‘Vickrey’ second-price auctions for delayed sums of money. Following this, participants completed the Moral Foundations Questionnaire (MFQ), and the Self Importance of Moral Identity scale (IMI). Contrary to predictions, Delay discounting rates were positively—rather than inversely—associated with all the Moral Foundations but Authority. Education mediated the relationship for the Binding, but not the Individualising moral foundations. We propose that the observed relationships may be explained by individual differences in loss aversion, mediated by tendency to adopt an abstract mindset when considering moral issues.
Education Mediates the Relationship Between Temporal Discounting Rates and Communal, but not Individual, Moral Foundations.

'I say that a man must be certain of his morality for the simple reason that he has to suffer for it.'

G. K. Chesterton

While a body of research is accumulating with respect to moral concepts and their apparent impact on subsequent behaviours (Pichon, Boccato & Saroglou, 2007; Shariff & Norenzayan, 2007) the types of moral attitudes that likely support these relationships are not well understood. Studies investigating secular moral attitudes have tended to focus on concerns for Fairness or Care, but have neglected other secular moral values; namely, the communal and sacred moral attitudes that are included in contemporary moral taxonomies (Graham, Nosek, Haidt, Iyer, Koleva, & Ditto, 2011; Haidt & Joseph, 2004; 2006).

Moreover, while the pro-social behaviour affected by exposure to moral concepts probably requires some form of impulse control (Baumeister & Exline, 1999), few studies have examined impulsivity using indirect measures when studying its association with moral attitudes (but see Crockett, Clark, Liebermann, Tabibnia, & Robbins, 2010 for an exception). This is important as self-report measures of impulsivity like the Barrett Impulsivity Scale (Barratt, 1965, 1985; Patton, Stanford, & Barratt, 1995) return estimates of impulsivity that differ reliably from indirect measures of impulsivity such as Kirby and Marakovic’s (1996) Monetary Choice Questionnaire (McLeish & Oxoby, 2007).

Temporal discounting (TD) rates are a desirable measure of impulsivity in that they rely on decisions about delayed rewards rather than self report about attitudes and past behaviours. However, even the Monetary Choice Questionnaire, which presents a series in forced binary choices about immediate versus delayed financial rewards, may
be subject to social desirability, although probably to a lesser extent than questions that address impulsivity explicitly. A participant may select the ‘later, larger reward’ option to appear more patient (see Chapter 6 for a more thoroughgoing exposition of the confounding effects of social desirability in research on religious concepts).

What is more, different procedures for measuring discounting rates yield systematic differences in the correlations between the TD rates obtained and other cognitive variables of interest. For example, Shamosh and Gray (2007) observed that the association between discounting and intelligence quotient differed depending on whether the outcome of the decisions were always hypothetical, always real, or whether pay-off was a matter of chance.

It is also possible that the structure of decisions in different temporal discounting procedures may have an effect. Where a decision must be made that requires no immediate inconvenience to the decider (e.g. $10 now or $20 in a week?) loss aversion may not be a factor. However, an equivalent present value procedure that requires participants bid with their own funds (e.g. how much will you pay ‘now’ for $10 in three days?), may elicit more conservative responses. The present study altered the methodology used in Chapter 2, using an equivalent present value temporal discounting measure (discussed in Chapter 3) to address the same hypotheses and investigate the valence of moral items as a potential confound.

In Chapter 2, the Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996) was used as a hypothetical procedure, together with the Moral Foundations Questionnaire (MFQ31; Graham & Haidt, 2009) in order to examine associations between impulsivity and moral attitudes. We reasoned that those with lower TD rates would be better able to suppress selfish impulses and follow internalised moral rules. Perceiving themselves behaving pro-socially would lead them to conclude that being a moral person is part of their identity (Bem, 1967, 1972). Thus there would be a
negative association between TD rates and scores on the ‘Self Importance of Moral Identity Scale’ (IMI; Aquino & Reed, 2002). Having a sense that one is a moral person should, according to self-presentation theory, encourage greater endorsement of whatever moral foundations the participant had internalised (Hardy & Carlo, 2005). This relationship would be the same whether one emphasised individuals’ or the communities’ needs in their moral attitudes. Thus, TD rates would be negatively associated with Moral Foundations scores, but the association would be mediated by the extent to which one believed morality was part of their identity.

On the other hand, we expected that education level would differentiate between the Individual (Fairness & Care) and the Binding moral foundation (Loyalty, Respect & Purity) scales of the MFQ. Specifically, it was predicted that lower TD rates would predict greater persistence with formal education, which has been demonstrated to increase endorsement of liberal and open political views (Luguri, Napier, & Dovidio, 2012; Weakliem, 2002). Those with liberal political orientations tend to value the individual moral imperative of compassion (Hirsh, DeYoung, Xu, & Peterson, 2010) as well scoring more highly on measures of fairness and care on the MFQ (Graham & Haidt, 2009; Graham et al., 2011). The expected relationships were not detected in the study reported by Chapter 2.

However, scores for loyalty (MFQ) and the self-importance of moral identity were associated with scores on the Zimbardo Time Perspective Inventory (ZTP; Zimbardo & Boyd, 1999) in Chapter 2. In turn, those who believe the appropriate locus of concern lies in the future (ZTP; ‘Future’ scale) had lower TD rates, while those with a ‘Fatalistic’, present focused attitude had higher TD rates. In Chapter 2 we speculated that the temporal discounting rates obtained by the hypothetical MCQ might reflect participants’ beliefs about how they should make decisions. This may not align with how they decide when their own resources are at stake. This is not a trivial issue, since
many ‘real life’ moral decisions concern opportunity cost. Does one sponsor a child in poverty or buy a better car?

In the present study an equivalent present value (or matching) procedure was employed; specifically, a series of second-price auctions for delayed money. The procedure required that participants supply and bid with their own money, making it one of few studies to do so (Harrison & McKay, 2012; Kirby & Santiesteban, 2003; Kirby, Winston, & Santiesteban, 2005).

The study also investigated whether the valence of items in the Moral Foundations Questionnaire, used in Chapter 2, may have confounded the results. Items that describe moral wrongdoing (for instance ‘to kill a human being’) may have a different relationship with impulsivity than positively valenced ones (‘to share’). Crockett et al. (2010) found that temporal discounting (TD) rates predict the tendency to punish transgressions (altruistic punishment) in an ‘ultimatum game’; the higher one’s discounting rate, the more likely a receiver was to punish an inequitable offer from the giver. This contrasts with studies indicating a negative relationship between discounting rates and cooperative behaviour; which probably indicates a similar moral attitude, namely a concern for fairness (Curry, et al., 2008; Yi, Johnson & Bickel, 2005). Punishment is pro-social as it enforces co-operation by providing a deterrent to defection at a cost to the actor. However, the presentation of moral transgressions may differ from positively valenced moral scenarios in that they elicit arousal, manifesting as emotions like anger. Arousal may increase temporal discounting rates (Wilson & Daly, 2003).

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13The ultimatum game involves two players. The ‘proposer’ may offer any portion of their stake (e.g. $3 out of $10 dollars) to a ‘receiver’, who can accept or reject the offer. If the offer is accepted the money is divided as proposed. If it is rejected, neither player receives any money. From a pecuniary point of view it is rational to accept any offer. However, receivers frequently reject low offers, punishing the proposer to their cost.
Positively and negatively valenced items are found within the same scales on the Moral Foundations Questionnaire. Thus, if those with high TD rates respond with greater magnitude to items in the MFQ31 that describe transgressions (similar to Crockett et al. 2010) stable negative correlations between TD rates and moral attitudes described by positively valenced items—in the same scale—may have been obscured. If, as we predicted in Chapter 2, those with lower TD rates score more highly on the MFQ, it may be this is only the case for positively valenced items. Of course, behaviours described in studies like Curry et al. (2008) and Yi et al. (2005) may not align with moral attitudes (the focus of our study). But self-perception (Bem, 1967, 1972) and cognitive dissonance theory (Festinger, 1957) indicate that regardless of causal direction, attitudes and behaviour tend to converge. Thus, the possibility is worth investigating. To this end, associations between responses on the MFQ and TD rates were compared according to item valence.

Method

Participants

Fifty-three participants (42 females; Mean age = 28.13, SD = 11.95) at two campuses of a regional Australian university were recruited via the university email and research participation system. Thirty-six participants were undergraduate students, six had completed an undergraduate degree while the remaining 11 (21%) had completed at least one graduate or postgraduate qualification. Participants were paid AUD$10.00 for participation.

Materials and Procedure

Temporal discounting; Equivalent present value procedure.

The method used in the present study was originally used by Kirby and Santiesteban (2003). Prior to the session, participants were contacted by email and informed that they were required to bring AUD$30.00 with them in order to bid in a
series of auctions. No volunteer declined to participate as a result of this requirement.

In a series of 30 ‘one shot’ Second Price auctions, participants were asked to nominate an amount they were prepared to pay ‘now’ for a delayed sum of money in a series of ‘Vickrey’ Second Price auctions (Vickrey, 1961)\(^\text{14}\). For example, participants were asked how much they would pay ‘now’ for $29.90, to be received in 35 days. The auctions were conducted on IBM computers using the Dreamweaver application.

Participants completed three practice auctions prior to data collection. Two amounts of money were presented (AUD$9.90 & $29.90), with the amount alternating on each trial. Delays (of 1, 2, 3, 4, 5, 7, 11, 15, 19, 23, 27, 31, 35, 39 and 43 days) were presented in the same order for each participant. However, the order of delays was randomised so that there was no correlation between delay amount and the order of the auctions.

After entering a bid, participants were directed to a second screen where they were asked whether they would like to ‘keep their money’, ‘wait for the delayed money’ or whether those options ‘feel about the same to me’. This measure was intended to reinforce the instruction that participants should bid to ‘break even’ and provided an opportunity to fine-tune their bid (Kirby & Santiesteban, 2003). If the ‘keep money’ option was selected, participants were instructed to adjust their bid downwards, whereas if they selected the ‘wait’ option they were instructed to raise their bid (by $0.10 increments). This process could be repeated until the participant selected the ‘feels about the same’ option, at which point their final bid was recorded. Full instructions may be inspected in Appendix A.

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\(^{14}\) According to Vickrey (1961), asking the highest bidder to pay the amount of the second highest bid encourages bidders to bid what the delayed item is really worth to them because it ensures the bidder will make a small profit should they win the auction. Thus the most profitable strategy is to bid to ‘break even’. Strategically inflated bids are discouraged because of the possibility that the second highest bid may also be higher than the winning bidder wished to pay.
At the conclusion of the auctions, a random number between 1 and 30 was selected, determining which auction would be paid out. The highest bidder was invited to complete the transaction by paying the amount placed by the second highest bidder (Vickrey, 1961). To control transaction costs regardless of delay, the delayed amount was received by presenting the receipt at the university’s psychology office once the nominated time delay (1 – 43 days) had elapsed. This procedure has adequate temporal stability and convergent validity with other measures of temporal discounting (TD), reliably detecting oft described age, education and magnitude effects (Harrison & McKay, 2012).

Moral Foundations Questionnaire (MFQ30; Graham et al., 2011).

Participants then completed the Moral Foundations Questionnaire. The instrument has two parts. The first presents 16 statements and asks participants to rate the extent to which they take each statement into account when deciding if an act or situation is right or wrong (e.g. ‘Whether someone was treated unfairly’). The subsequent 16 items ask participants to rate their level of agreement with statements regarding moral concerns (e.g. ‘It can never be right to kill a human being’). One ‘catch’ item from each section is omitted from the final scoring.

Test–retest Pearson correlations for each foundation score are .71 (Harm/Care), .68 (Fairness/Equity), .69 (Ingroup), .71 (Authority), and .82 for Purity (Graham, et al., 2011, p. 6). Like its predecessor, the MFQ31, the scales show adequate predictive validity for attitudes one would expect to find in particular sections of the community (for instance, vegetarians score highly on ‘Harm/Care’) (Graham, et al., 2011)\(^\text{15}\).

\(^{15}\) Since the MFQ31 used in Harrison & McKay returned poor reliability estimates, the present study uses the revised version – MFQ30 (Graham, et al., 2011).
Zimbardo Time Perspective Inventory (ZTPI; Zimbardo & Boyd, 1999).

Scores for the 52 Likert-type items on the ZTPI load onto five scales. ‘Future’ orientated respondents tend to endorse delaying gratification in pursuit of future rewards. Those who endorse ‘Present Hedonistic’ items place a large personal emphasis on enjoying pleasures in the moment, while the ‘Present Fatalistic’ scale measures the extent to which respondents believe their lives are determined by external forces. Higher endorsement of items in the ‘Past Positive’ scale indicates a nostalgic view of one’s past while endorsing ‘Past Negative’ scale items indicates the opposite view of one’s past. The scales are internally consistent with Cronbach’s alpha coefficients of .77 (Future), .79 (Present Hedonistic), .74 (Present Fatalistic), .80 (Past Positive) and .82 (Past Negative) (Zimbardo & Boyd, 1999).

**Self Importance of Moral Identity (IMI; Aquino & Reed, 2002).**

The Self Importance of Moral Identity Scale is a ten-item Likert scale, the scores for which load on two factors. Internalised Moral Identity (Cronbach’s α = .77) reflects the extent to which the respondent believes that morality forms part of their identity, regardless of whether or not others are aware of it. Symbolised Moral Identity (Cronbach’s α = .76) concerns the extent to which respondents believe that they present to others as a moral person by virtue of their affiliations and activities. The scales are well validated using self-report and behavioural observation (Aquino & Reed, 2002).

**Results**

Inspection indicated an orderly data set. While no multivariate outliers were detected, the MFQ30 catch item identified a uniform response set from one participant, who was excluded from further analysis. Leverage and Cook’s D analysis returned maximum values of .61 and .18 respectively, indicating that no cases were likely to
Exert disproportionate influence on subsequent correlation estimates (Cook & Weisberg, 1982; Muller & Mok, 1977).

Bidding data were analysed separately for all participants to avoid artefactual biases introduced by drawing parameter estimates from aggregate data (Kirby, 1997). Discounting estimates (‘k’) were estimated using iterative, nonlinear regression, employing the hyperbolic form below (equation 1).

\[
V = \frac{A}{1 + k \cdot d}
\]

(1) Mazur (1987)

Above, \(V\) represents the discounted value of reward \(A\), and \(d\) the units of delay (days). Solving for \(k\) provides a discounting rate in the unit interval, assuming that values decrease with added delay. The hyperbolic model is favoured over exponential utility discount functions due to its broad empirical support (Murphy, Vuchinich, & Simpson, 2001; Vuchinich & Simpson, 1998).

Discounting rates were also estimated atheoretically by measuring ‘Area Under the Curve’ (AUC) using the trapezoid summation method based on equation two below:

\[
\sum (x_2 - x_1) \left[ \frac{(y_2 + y_1)}{2} \right]
\]

(2) Myerson, Green and Warusawitharana, (2001)

Area Under the Curve (AUC) estimates of individual discounting rates do not include the residual error (RMSE) inherent in model-based iterations (Myerson, et al., 2001). Discounting rates were calculated separately for the smaller ($9.90) and larger ($29.90) amounts before taking the geometric mean of both as a total estimate of discounting for each participant.
Theoretical ‘k’ parameter estimates for the model equations were skewed and kurtotic, logarithmic transformation rendered the data suitable for parametric analyses and analysis of indirect effects. AUC estimates did not violate the assumptions required for parametric analyses. Obtained discounting rates displayed the expected effects for age, education and magnitude (Madden & Bickel, 2010; Odum & Baumann, 2010). Discounting rates (using hyperbolic ‘k’ parameters) decreased as a function of the respondents’ age, \( r(50) = -0.387, p = 0.005 \) and education, \( r(50) = -0.385, p = 0.005 \). Discounting for the smaller delayed reward of \$9.90\) was greater \( (M = 0.352, SE = 0.082)\) than for the larger reward of \$29.90\) \( (M = 0.211, SE = 0.071, t(50) = 8.88, p < 0.001, d = 0.53)\).

Rates of discounting were significantly higher for the present study \( (M = 0.26, SD = 0.07)\) than for Harrison and McKay (Chapter 2) \( (M = 0.025, SD = 0.002, t(120) = 8.69, p < 0.01)\). The participant sample in Chapter 2 had a larger proportion of respondents with graduate and postgraduate qualifications (65% vs. 21%) and were significantly older, \( t(220) = 4.476, p < 0.001, d = 0.67\). A more comprehensive comparison of descriptive statistics with Chapter 2 can be found at Appendix b.

Hyperbolic temporal discounting rates were significantly and—contrary to predictions—positively associated with scores on the Moral Foundations of Care, Fairness, Ingroup Loyalty and Purity. The coefficient for Authority trended in the positive direction but fell short of significance (see Table 1). Comparing correlation coefficients by transforming them to standardised Fisher’s ‘z’ values revealed that correlation coefficients between the MFQ and TD rates for the present study were not only significant in themselves, but also significantly higher than the correlation coefficients described in Chapter 2 on all five foundation scores (Care, \( z = -2.71, p = 0.01\); Fair, \( z = -2.38, p = 0.02\); Ingroup, \( z = -2.04, p = 0.04\), Authority, \( z = -2.36, p = 0.02\), Purity, \( z = -2.56, p = 0.01\)). While age was not related to scores on the MFQ30,
education displayed moderate, negative associations with the Binding foundations ‘Ingroup’ Loyalty ($r(50) = -0.321, p = .02$), Authority ($r(50) = -0.409, p = .003$), and Purity ($r(50) = -0.406, p = .003$).

We used nonparametric bootstrapping analyses (see Preacher & Hayes, 2004; Preacher, Rucker, & Hayes, 2007; Rucker, Preacher, Tormala, & Petty, 2011) to test whether education mediated the relationship between temporal discounting rates (using transformed hyperbolic model estimates) and scores on the Moral Foundations Questionnaire. TD rates showed significant indirect effects—via Education—on scores for Purity ($z = 0.127, SE = 0.071, p = .019$) and Authority ($z = 0.142, SE = 0.072, p = .010$). Direct effects were non-significant, indicating that education mediated the association (Fig. 1 & 2). Direct and indirect effects between TD and Ingroup Loyalty were not significant in spite of detecting a significant total effect (Fig. 3).
Table 1
Pearson’s Bivariate Correlation Coefficient Between Temporal Discounting and the MFQ30, ZTI, Self Importance of Moral Identity and Self Knowledge Scale.

<table>
<thead>
<tr>
<th>Scale</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
<th>12.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounting</td>
<td>1.</td>
<td>Discounting (Hyperbolic)</td>
<td>1.00</td>
<td></td>
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<td></td>
<td>2.</td>
<td>Discounting (AUC)</td>
<td>-.985**</td>
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<tr>
<td>MFQ30</td>
<td>3.</td>
<td>Care</td>
<td>.459**</td>
<td>-.463**</td>
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<tr>
<td></td>
<td>4.</td>
<td>Fairness</td>
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<td>-.318*</td>
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<td></td>
<td>5.</td>
<td>Ingroup</td>
<td>.317*</td>
<td>-.295*</td>
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<td></td>
<td>6.</td>
<td>Authority</td>
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<tr>
<td></td>
<td>7.</td>
<td>Purity</td>
<td>.328*</td>
<td>-.322*</td>
<td></td>
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<td>ZTI</td>
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<td>Future</td>
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<td>Present Fat.</td>
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<td>Self-Importance of Moral Identity</td>
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<td>IMI - internal</td>
<td>.126</td>
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<td>.390**</td>
<td>.237</td>
<td>.118</td>
<td>.222</td>
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<td>14.</td>
<td>IMI - symbolised</td>
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<td>.345*</td>
<td>.360*</td>
<td>.153</td>
<td>-.061</td>
<td>.284*</td>
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*p < .05 ** p < .01
Figure 1. Analysis of mediation model with Education as a mediator of the effect of TD rates on concern for the Moral Foundation of Purity. Based on 10,000 bootstrapping samples; bias corrected estimates. Standard Errors are shown in parentheses.

Figure 2. Analysis of mediation model with Education as a mediator of the effect of TD rates on concern for the Moral Foundation of Authority. Based on 10,000 bootstrapping samples; bias corrected estimates. Standard Errors are shown in parentheses.

Figure 3. Analysis of mediation model with Education as a mediator of the effect of TD rates on concern for the Moral Foundation of Ingroup Loyalty. Based on 10,000 bootstrapping samples; bias corrected estimates. Standard Errors are shown in parentheses.
‘Progressivism’ provides a measure of libertarianism as a function of the
difference between average scores on the Binding foundations (Loyalty, Authority and
Purity) and scores on the Individualising foundations (Care and Fairness). Temporal
dISCOUNT rates were associated with Progressivism only indirectly, via education, z = .136, SE = .078, p = .025 (Fig. 4).

Contrary to predictions, the relationship between TD rates and the
Individualising moral foundations were not mediated by education. Large significant
total and direct effects were detected between TD rates and the 'Fairness' scale (z_{total} = .334, SE = .128, p = .014; z_{direct} = .295, SE = .141, p = .011 respectively) as well as the
'Care' scale (z_{total} = .459, SE = .106, p < .001; z_{direct} = .453, SE = .116, p < .001 respectively). Indirect effects were not significant. Also contrary to predictions, scores
on the Self Importance of Moral Identity Scale bore no relationship with obtained TD
rates, and did not mediate the relationship between TD rates and scores on the MFQ30.

Finally, in light of the possibility that items describing moral transgressions may
produce different effects from positive or neutral items, the correlation coefficients
between TD rates and every item of the MFQ30 were examined. Items in the MFQ30
which described a moral transgression ($M = .22, SE = .03$) were more highly correlated with TD rates than items which did not ($M = .15, SEM = .03$, $r(13) = 9.619, p < .001, d = 2.69$, two tailed paired samples). While interesting, the coefficients for both categories trended to positive correlations the concern that the effects of one category would mask effects of the other were not founded.

**Discussion**

Contrary to predictions that relationships between temporal discounting (TD) rates and the Moral Foundations, would be inverse, significant positive relationships were detected between obtained TD rates and the Individualising and Binding foundations. Moreover, while we predicted that TD rates would have a negative association with the Individualising foundations, mediated by education, it turned out that education did not mediate the relationship. This unexpected finding is made more intriguing by the finding that the positive associations between TD rates and the Binding foundations were mediated by education.

Presumably, the less impulsive one is, the longer one is likely to persist with education, sacrificing free time and tolerating relative poverty to achieve longer term ambitions. Moreover, lower TD rates predict better academic achievement (Duckworth & Seligman, 2008 Kirby, Winston & Santiesteban, 2005). In the present study, education predicted lower endorsement of conservative attitudes. This is congruent with Luguri et al. (2012) who found that instructing participants who reported holding conservative political views to take an abstract mindset increased tolerance for perceived out-groups.

Nevertheless, it is possible that education does not cause abstract thinking, much less liberalism; perhaps a pre-existing tendency toward abstract cognition makes higher education attractive. However, Luguri and colleagues’ (2012) experimental
manipulation of cognitive approach suggest that changes to cognitive approach do cause a shift in attitude. So presumably those with lower TD rates achieve higher educational status, and this educational experience reduces endorsement of conservative or Binding moral foundations. Thus, discounting rates are associated with endorsement of the Binding foundations indirectly, via education.

The difference between individuals’ endorsement of the Individualising foundations (Care, Fair) versus the Binding foundations (Ingroup, Authority, Purity), as measured by the Progressivism scale, was also indirectly associated with temporal discounting rates via education. It was predicted that higher education would be associated with increases in endorsement of the Individualising moral foundations. However, while higher TD rates predicted lower education levels, lower education predicted greater endorsement of the Binding foundations rather than lower endorsement of the Individualising foundations. As scores on the Binding foundations rise, the differences between them and the Individualising foundations probably reduces, lowering scores on the Progressivism scale.

That endorsement of Moral Foundations is positively associated with our measure of discounting seems at odds with observations that lower impulsivity is associated with greater cooperativity (Curry, et al., 2008), but only if one assumes that greater cooperativity reflects a greater concern for moral values. Differences between the present study’s methodology and Harrison and McKay’s (Chapter 2) methodology may lend insights into the issue.

First, Harrison and McKay’s discounting measure was hypothetical, while the present study involved participants’ money. While decisions about real money resulted in higher discounting rates than hypothetical ones, we agree with Kirby (1997) and Johnson and Bickel (2002) that this can probably be explained by the fact that smaller
amounts are discounted more (the ‘magnitude’ effect). Where reward size is controlled for, real and hypothetical methods produce similar TD rates (Odum & Baumann, 2010). Thus it is more likely that the differences between Chapter 2 and the present study reflect differences between choice and equivalent present value procedures.

It is unlikely that the Monetary Choice Questionnaire (MCQ; as used in Harrison & McKay, Chapter 2) produced a sense of loss aversion, while the present study probably would have triggered a ‘loss averse’ mindset. The MCQ presents participants with choices between taking a small amount of money now, or a larger amount later. Both choices are a positive departure from one’s present reference point; whatever they choose, respondents end with more than they started with. Even the delayed choice is an addition to their financial position (Frederick, Loewenstein, & O'Donoghue, 2003). In the present study, participants made decisions that always included a negative departure from their present reference point; whatever their decision, it involved agreeing to part with the money they had brought with them. In our auctions, lower bids denote higher discounting rates, and loss aversion may have encouraged lower bidding. While auction winners would recover their funds after the specified delay, Loewenstein and Prelec (1992) point out that in scenarios where consumption is delayed, as in the present study, loss aversion increases temporal discounting (TD) rates.

There are reasons to suspect that moral attitudes may also be affected by loss aversion. Moll, de Oliveira-Souza, et al. (2002) found that participants viewing images of moral transgressions (e.g. violent assaults or neglected children) showed increased activation of the right orbitofrontal cortex compared to participants viewing unpleasant but morally neutral images. Unpleasant and ‘moral’ images both resulted in activation

16 The well documented ‘Endowment Effect’ (Knetsch, 1989) was not likely to be an issue, as participants would not have received any money at the time the choice was made even if the decisions were real.
of the amygdala. Thus, moral issues produce affective responses. However, Social Intuitionist Theory goes so far as to argue for the primacy of affective responses, to which moral rationalisations are added post hoc (Haidt & Bjorklund, 2008a, 2008b; Saltzstein & Kasachkoff, 2004). This is an important point in the interpretation of the present results.

The items in the MFQ implicitly require an assessment of how unpleasant the effects of transgressing those moral situations may be (betraying one's country for instance). Of course, the more attachment one feels to a moral attitude (loyalty in the foregoing case) the more unpleasant one is likely to believe transgression or failure in terms of that moral foundation will be.

Not coincidentally, loss aversion has also been described as an exercise in affective forecasting. Kermer, Driver-Linn, Wilson and Gilbert (2006) conclude that loss aversion is an 'affective forecasting error' (p. 649); loss averse participants tended to overestimate how bad a loss would make them feel.

More extreme affective forecasts with regards to moral concerns appear to correlate positively with how reluctant one is to bid large sums in our 'one shot' auctions. This account has the advantage of explaining why correlations were not detected between TD rates and Moral Foundations in Chapter 2 but were detected in the present study. Having recourse to Loewenstein and Prelec's (1992) reference-point model of temporal discounting (TD), loss aversion also accounts for the significantly larger TD rates in the present study.

Loss aversion, according to Kermer et al. (2006) arises from automatic and defensive overestimations of the hedonic impact of a disappointment/loss (p. 649). To use Kahnemann's (2011) distinction, loss aversion arises from System 1 with little conscious effort. System 1 cognition governs decisions that are guided by habit,
intuition, and emotion. For example, where a deliberative decision not to eat animals anymore means that the author will have a green salad instead of ham for lunch, there is no need to engage one’s philosophical reasoning to decide between them at each lunchbreak. System 2, effortful and deliberate, only intervenes in these automatic processes should the need arise. If the usual green salad is unavailable, the habits and intuitions of System 1 are no longer helpful, and deliberative reasoning (System 2) must be engaged to decide if the egg salad is better than nothing.

Luguri et al. (2012) provide a telling illustration of this where the conservative attitudes are concerned. When participants were instructed to adopt a System 2, cognitively effortful approach (to an unrelated topic - health), tolerance for members of perceived out-groups increased; this increase was mediated by an increase in scores on the ‘Fair’ scale of the Moral Foundations Questionnaire (study 3). Luguri and colleagues’ results accord with our finding that education mediates the relationship between the binding foundations and TD rates. Higher education, regardless of the topic area, encourages abstract (System 2) thinking, which is incompatible with the kind of affective, automatic responses that characterise loss aversion as described by Kermer, et al. (2006).

Moreover, when there is a conflict between the two, System 2 ‘normally has the last word’ (Kahneman, 2011, p. 25). The abstract mind-sets fostered by increased education are likely to trump the automatic ‘affective forecasts’ concerning the importance of the Binding foundations, as they come into conflict with abstract moral concerns taught explicitly in educational institutions (Luguri et al., 2012). Educational institutions in diverse societies like the US and Australia go to great efforts to stress the principles of equality and freedom from exclusion or discrimination. In addition, western culture espouses the high ideals of individual rights as a worthy goal (Luguri et
al., 2012). However, if education increases concern with ‘Fairness’ principles, why didn’t education mediate the relationship between TD rates and the Fairness foundation?

The most likely explanation is that the abstract principles of Fairness and Care (e.g. ‘equality’ in university codes of conduct, by-laws and constitutions) were congruent with the empathetic, emotional System 1 responses to the items presented in the ‘Fairness’ and ‘Care’ scales (e.g. ‘to kill a human being’). If education increases the likelihood of using abstract mindsets, education will affect responses to moral items on the MFQ only if System 2 cognition is required. In the case of the Individualising foundations, where there is no conflict, there’s no need to deploy System 2 effortful deliberation when System 1 will do the job (Kahneman, 2003, 2011). Thus, the affective responses to Fair and Care based moral items remained unattenuated by educational levels.

Finally, this explanation accounts for the finding that items on the MFQ that described transgressions correlated with TD rates to a greater degree than other items, but in the same direction (positively). The highest correlations with TD rates occurred with the most specific and potentially threatening items (e.g. ‘hurt a defenceless animal’ or ‘kill a human being’) from the ‘Care’ scale of the MFQ. Such items would naturally produce more extreme affective forecasts of the hedonic impact of experiencing/witnessing such an event than neutral items like ‘It is more important to be a team player than to express oneself’.

With regard to practical issues, the fact that the present methodology involves loss aversion, while the Monetary Choice Questionnaire (MCQ) does not, should not be regarded as an impediment to using either method. Rather, we suggest that it would be beneficial for researchers to maximise the ecological validity of their results by giving
due consideration to the kinds of ‘real world’ decisions they are trying to investigate. For example, some health behaviours may be best modelled as ‘small gain now / large gain later’ decisions. Suppose one is offered a chocolate dessert while working toward a long-term weight loss goal; a small gain now (a pleasurable dessert, but a delayed or forfeited weight loss goal) versus a larger gain later (weight loss by targeted date). Where decisions of this nature are at issue, the Kirby and Marakovic’s (1996) Monetary Choice Questionnaire may be a good choice; loss aversion may not have a role. Alternatively, a decision between committing a few thousand dollars into a high interest term deposit (and receiving a greater amount when the fund matures) versus spending the money now may be a decision where loss aversion might matter. Such decisions are likely to be affected by loss aversion and thus probably best represented by the method employed in the present study.

Potential differences in the structure of decisions are an important issue for environmental psychology. The bulk of studies examining environmental outcomes and discounting have included transgressions producing disastrous results, and measuring affective reactions to losses (Böhm, 2003; Böhm & Pfister, 2005; Gattig & Hendrickx, 2007; Hendrickx & Nicolaïj, 2004). Arguments that environmental campaigns should ‘appeal to peoples’ long term preferences’ where cooperative behaviours are concerned (e.g. recycling) is based on research that often describes participants’ reactions to misdeeds (Gattig & Hendrickx, 2007, p. 21). Responses to disaster scenarios may not be readily generalizable to decisions about whether to catch a bus instead of drive, or recycle bottles. While Böhm and Pfister (2005) argued that moral concerns may make environmental issues ‘partly immune to time perspective’ (p. 461), our results indicate this may be too simplistic. Decisions that elicit affective responses (being sensitive to loss aversion) have different relationships with
discounting than those that elicit abstract, analytical responses; especially where moral attitudes are concerned.

Hardisty and Weber’s (2009) study is edifying on this point; the authors studied time preferences for environmental, economic, and health gains/losses. Their environmental loss/gain scenarios did not describe misdeeds or induce anxiety, but instead concerned small policy driven changes in environmental health (e.g. air quality). Moreover, the scenarios required fairly complex decisions that would have required deliberation; System 2 processing. In contrast to the studies mentioned above, Hardisty and Weber detected no differences in discounting between environmental and economic outcomes.

The present study indicates that moral concern for individuals (Care and Fair foundations) differ from moral concern for social cohesion and sacredness (particularly the Authority and Purity foundations) in that the relationships with impulsivity are mediated by education only for the latter. Thus it appears that appealing to moral concerns in an effort to change immediate behaviours may be a more complex proposition than previously supposed. Indeed, as G. K. Chesterton suggests in the opening quote, it may be that moral concerns are most salient to temporal discounting when a genuine cost (and thus loss aversion) is a factor.

It also appears that the content of one’s ‘moral’ education is a factor in the relationship between impulsivity and moral attitudes. If the moral attitude in question comes into conflict with the content of one’s education, abstract System 2 cognitions are engaged, mediating the relationship. This possibility could be tested by replicating the present study in educational institutions where Binding foundations are emphasised. A military officer’s school, a traditional martial arts dojo or religious seminary may be appropriate settings. In an environment where loyalty, deference to authority and
orderliness are emphasised as the crucial virtues of group membership, the period of time spent in that institution might mediate the relationship between our temporal discounting measure and endorsement of Individualising, rather than the Binding, moral attitudes. Such a research program would be a fruitful and welcome avenue for further investigation, and may shed further light on the relationship between education and its effects on moral affect and cognition.
References


Chapter 5

Abstract

Psychological accounts of morality frequently assume that restraint of impulsivity is a necessary condition for moral conduct. Researchers have purported to show that reductions in temporal discounting (TD) rates occur when participants are presented with scenarios where moral concerns are salient (Böhm & Pfister, 2005). While there is evidence that TD rates are negatively associated with contributions in economic games, there has been no direct test of the hypothesis that impulsivity reduces in response to moral cues. Forty-six participants were allocated to a moral or control prime condition, and used their own money to bid on delayed amounts of money. Bids were used to calculate temporal discounting rates. In a second session discounting rates were measured again without priming. Contrary to our hypothesis that moral cues would decrease TD rates, significant within-group increases in temporal discounting were detected for the moral condition group, but not the control group. The results are considered in light of research demonstrating that good news about one’s social reputation is rewarding. If behaviour that is congruent with social rules is intrinsically rewarding, and the prospect of reward increases discounting (Wilson & Daly, 2003), the role of impulsivity in moral psychology deserves reconsideration.
Is Virtue its Own Reward? Priming Positive Moral Concepts Increases

Temporal Discounting Rates.

In 2009, shopkeeper Dave Phillips threw himself at a bayonet-wielding teenager in the defence of another young man the assailant had just stabbed. Phillips was wounded in the ensuing fight, during which two women came to the aid of the dying victim, placing themselves in harm’s way a few feet from the struggle. None of the parties were known to each other. Phillips, whose safety had not been threatened by the assailant, later claimed he had no choice other than to respond as he did (Strachan, 2011).

Although Phillip’s actions appear impulsive and moral, the assumption that impulsivity is antithetical to moral conduct has been ubiquitous in the philosophical (Korsgaard, 1986; Smith, 1759) and psychological literature (Baumeister & Exline, 1999). Graham, Haidt and Rimm-Kaufmann (2008) argued that morality was best defined as an “interlocking set of evolved psychological mechanisms that work together to suppress or regulate selfishness and make social life possible” (p. 271, italics added). Baumeister and Exline (1999) went as far as to argue that self-control “can fairly be regarded as the master virtue” (p. 1189). But what is the evidence that self-control influences, or is influenced by moral concerns? In the present study we review literature that indicates the relationship between impulsivity and morality is more complex than it first appears, and progress the issue with a direct experimental investigation.

Temporal Discounting: A Measure of Behavioural Impulsivity

Hyperbolic temporal discounting (Ainslie, 1992, 2001, 2002; Soman et al., 2005) refers to the observation that the subjective value of a reward or consequence reduces as a function of increasing delay until its realisation (Kirby, 1997). This effect is
usually described by hyperbolic models (but see Read (2001) for a dissenting view).

Steep discounting occurs at the introduction of any delay, followed by lesser decreases in value as successive delays are added (Critchfield & Kollins, 2001; Kirby, 2006; Schweighofer et al., 2006). Hyperbolic models of discounting have the advantage of being able to account for changes of preferences when rewards become immediately available. For example, one may prefer 25 dollars in 92 days over 20 dollars in 90 days, but prefer 20 dollars with no delay to 25 dollars in two days. Temporal discounting rates can be obtained using forced binary choice questions (as above) or by ‘equivalent present value’ (EPV) procedures (e.g. “how much would you pay today for $21 in seven days?”) (Kirby, 1997). The present work adopted the latter method.

Temporal discounting is an advantageous measure of impulsivity for two reasons. First, as a behavioural measure it is amenable to experimental manipulation and the testing of causal hypotheses. Second, discounting rates correspond to the types of unplanned and pleasure seeking impulsivity\(^\text{17}\) that frequently enter public discourse in morally loaded terms; such as sexual conduct and drug use (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007; Kirby & Finch, 2010; Miller, Joseph, & Tudway, 2004). It is not surprising that self-reports of impulsivity are prone to social desirability biases, particularly in light of the fact that self-control is something of a by-word for moral conduct (Baumeister & Exline, 1999).

Correlational studies describe an inverse association between temporal discounting (TD) rates and cooperative behaviour. Lower TD rates are associated with fewer defections in iterated prisoner dilemma games with non-clinical (Harris & Madden, 2002; Yi, Johnson, & Bickel, 2005) and opioid dependent populations (Yi, Buchhalter, Gatchalian, & Bickel, 2007). Curry, Price and Price (2008) found that TD

\(^{17}\) Other factors described by commonly used self report impulsivity measures include Prepared/Careful, Impetuous, Divertible, Thrill and Risk Seeking, Happy-Go-Lucky, and Reserved (Kirby & Finch, 2010).
rates were inversely correlated with contributions in a one shot public goods game. Contributions were interpreted as prosocial acts in this game (Camerer & Fehr, 2004); thus the authors concluded that trait impulsivity is negatively associated with cooperation.

Crockett, Clark, Liebermann, Tabibnia and Robbins (2010) had participants take part in an ultimatum game where one participant offers another a portion of a stake they have received. The amount of the endowment is known to both players, and ‘receivers’ may accept or reject the ‘proposer’s’ offer. For ‘receivers’, accepting any offer is the profitable response. However, ‘receivers’ can, and do, reject offers if they believe the ‘proposed’ division is unfair. In the case of a rejection, neither player receives any money. Since rejection costs the ‘receiver’ money, the act is an altruistic censure of the ‘proposer’s’ inequitable offer. Participants with higher discounting rates were more likely to reject offers. Thus, this form of prosociality was positively associated with discounting rates.

While it is less clear whether social/moral cues may causally influence TD rates in either direction, a handful of studies from the environmental psychology literature suggest changes in temporal discounting as a result of moral cues. Böhm and Pfister (2005) presented participants with hypothetical news articles describing environmental destruction. Independent variables included the cause (human neglect versus natural causes) and a temporal manipulation whereby the consequences of the destruction would occur in the near (one month) or distant future (a decade). The authors measured emotional reactions to the articles, as well as the kind of emotions (fear, worry) and their intensity. The authors predicted that where destruction was the result of ‘natural’ causes, participants’ emotional responses would reduce as a function of delay. In the human cause condition, it was predicted the temporal manipulation would not affect
participants’ reactions (hypothesis 7, p. 464). In line with these hypotheses, weak
temporal effects were detected for the ‘natural causes’ condition, but none were
detected for the ‘human’ cause condition. Böhm and Pfister (2005) concluded that
(presumably human induced) “environmental risks, due to their strong moral
component, are partly immune to time perspective” (p. 461, italics added). Their
interpretation implies that moral cues act to reduce subsequent discounting rates.

In their study, Böhm and Pfister (2005) accepted significant reductions in the
dependent variables (as a function of delay) as evidence that discounting had occurred.
This is true of similar studies where variables have included estimates of seriousness,
emotional responses and desire to respond or punish (Gattig & Hendrickx, 2007;
Hendrickx & Nicolaij, 2004). In the above-mentioned studies, if respondents’
judgments of the ‘human caused’ loss were not significantly different with respect to
the time delay, temporal discounting was judged not to have occurred. Böhm and
Pfister’s results suggest that activation of moral concepts may reduce temporal
discounting, but doesn’t provide direct evidence, primarily because ‘absence’ of
discounting relies upon a null result. A statistically significant reduction in discounting
between conditions and/or treatments in response to exposure to moral cues would
progress the issue.

**Priming of Moral and Religious Concepts**

Activation of secular moral and (more often) religious concepts has been shown
to measurably influence subsequent behaviour. Supraliminal priming of religious
concepts results in larger offers in Dictator games (Ahmed & Salas, 2009; Ahmed &
Salas, 2011; Shariff & Norenzayan, 2007), fewer defections in Prisoner’s Dilemma
games (Ahmed & Salas, 2011), and reduced cheating (Randolph-Seng & Nielsen,
2007). Religious primes also increase the accessibility of pro-social concepts (Pichon,
Boccatto, & Saroglou, 2007), and secular moral primes increase giving in Dictator
Games (Shariff & Norenzayan, 2007; Study Two). Thus there is likely to be some
overlap between religious and secular moral concepts. Priming induced reductions in
impulsivity as an antecedent to other behaviour has some intuitive appeal, but has not
been directly demonstrated.

The relationship between impulsivity and moral concepts is further complicated
by the likelihood that research to date may have confounded positive moral concepts
(e.g. sharing) with moral transgressions (e.g. punishing). When Harrison and McKay
(submitted; Chapter 4) examined the relationship between temporal discounting rates
and scores on the Moral Foundations Questionnaire (MFQ30; Graham et al., 2011),
temporal discounting rates were correlated with items that described moral wrongdoing
to a significantly greater extent than items describing positive moral concepts. While
the difference was a matter of degree rather than direction, we agree with Crockett et al.
(2010) that where impulsivity is concerned, transgressions and positive pro-sociality
should be considered separately.

While exposure to moral wrongdoing might increase discounting at the prospect
of punishing a transgressor (Crockett et al., 2010), we suggest that activation of positive
moral concepts may reduce it. The censure of transgressors provides potential
reputational benefits by signalling that one is willing to uphold social rules (Boyd,
Gintis, Bowles, & Richerson, 2003; Jensen, 2010; McCullough, Kurzban, & Tabak,
2012), but it also carries the risk of retaliation. It may require impulsivity to ignore
immediate risks. Moreover, making moral transgressions salient may erode trust in the
future, lowering expectations that others will observe social norms. Uncertainty about
future events has been observed to increase discounting rates for unstable currency
(Ostaszewski, Green, & Myerson, 1998).
On the other hand, positive moral concepts may have the opposite effect; increasing expectations that others will behave normatively (therefore predictably), and suppressing impulsivity in the service of longer-term reputation benefits. Therefore we predicted exposure to positive moral concepts should lower temporal discounting rates.

The primes used in the present study reflected moral issues concerning ‘Fairness’ as described by Moral Foundation Theory (Graham & Haidt, 2009). In light of the finding that higher education tends to result in greater internalisation of Individualising moral concerns (Gaasholt & Togeby, 1995; Luguri, Napier, & Dovidio, 2012; Weakliem, 2002) the ‘fairness’ foundation was considered a good prospect for a priming effect with the subject population available.

It seems intuitive that morality is antithetical to impulsivity, and that the long term reward of a good social reputation may be easier to achieve if the impulse to take short term rewards could be suppressed. The activation of moral concepts may ‘ready’ the participant to compete for valuable social currency (reputation) by reducing impulsivity. As mentioned above, positive moral concepts may also increase the sense that others will observe social rules and are therefore predictable, reducing present oriented impulsivity by increasing trust in the future. In order to test this idea, we primed participants with positive secular moral concepts concerning ‘Fairness’, predicting a reduction in temporal discounting rates measured on a subsequent task.

**Method**

**Participants**

Forty-six participants (37 females; Mean age in years = 26.46, SD = 11.39) at two campuses of a regional Australian university were recruited via the university email and research participation system. Thirty-five were undergraduate students, five had vocational/trade qualifications while the remaining six participants had completed
at least one graduate or post graduate qualification. Participants were paid AUD$10.00 for participation after attending both sessions.

**Materials and Procedure**

**Priming instruments.**

Participants completed the exercises in groups of two to eight. On entering the laboratory for the first session, participants were randomly assigned to a neutral or moral priming condition. Our priming manipulation was the scrambled sentence task widely employed in supraliminal priming research (Bargh & Chartrand, 2000, 2005; Shariff & Norenzayan, 2007). Participants were given 20 sets of five words, from which they were required to construct meaningful four word sentences, omitting one word. In the moral priming condition, 13 of the 20 word sets contained words intended to prime the moral concern of equity and fairness. Observing Randolph-Seng and Nielsen’s (2008) recommendations, the moral connotations of the target words were obscured (e.g. ‘Acacias are drought tolerant’) as far as practicable. ‘Moral’ words were taken from the Moral Foundations Dictionary (‘Fair virtue’ entry; Graham & Haidt, 2009). The remaining seven sets, and all 20 in the control condition, contained neutral words which did not refer to socio-moral concerns. The task was presented as a pen and paper exercise and introduced as a ‘filler task’ while the databases were being set up for the following task. Participants were seated separately so they could not detect that the priming tasks differed. The full instruments may be inspected at Appendix C.

**Temporal discounting; Equivalent Present Value (EPV) procedure.**

Prior to the first session participants were contacted by email and informed that they were required to bring AUD$30.00 with them in order to bid in a series of auctions. No volunteer declined to participate as a result of this requirement. In a series
of 30 ‘one shot’ Second Price auctions, participants were asked to nominate an amount they were prepared to pay for delayed sums of money so that they believed they would just ‘break even’ (Vickrey, 1961). For example, participants were asked how much they would pay, for $29.90 to be paid in 35 days. Trials were presented on IBM computers using the Dreamweaver application. Two amounts of money were presented (AUD$9.90 & $29.90), with the amount alternating on each trial. Delays (of 1, 2, 3, 4, 5, 7, 11, 15, 19, 23, 27, 31, 35, 39 and 43 days) were presented in such an order that there was no correlation between delay amount and the order of the auctions. All participants received the auctions in the same order.

After entering a bid, participants were directed to a second screen where they were asked whether they would like to ‘keep their money’, ‘wait for the delayed money’ or whether those options ‘feel about the same to me’. This measure was intended to reinforce the instruction that participants should bid to ‘break even’ and provided an opportunity to fine tune their bid, raising the accuracy of obtained indifference points (Kirby & Santiesteban, 2003). If the ‘keep money’ option was selected, the participant was instructed to adjust their bid downwards, whereas if they selected the ‘wait’ option they were instructed to raise their bid (by $0.10 increments). This process could be repeated until the participant selected the ‘feels about the same’ option, at which point their final bid was recorded. Four practise trials were provided during which participants were encouraged to ask questions about the procedure.

At the conclusion of the auctions, a number between 1 and 30 was selected at random, determining which auction would be paid out. The highest bidder was invited to complete the transaction by paying the amount placed by the second highest bidder
(Vickrey, 1961)\textsuperscript{18}. To control transaction costs regardless of delay time, the delayed amount was received by presenting the receipt at the Psychology School office once the nominated time delay (1 – 43 days) had elapsed. This procedure has adequate temporal stability and convergent validity with other measures of temporal discounting (TD), reliably detecting oft described age, education and magnitude effects (Harrison & McKay, 2012).

**Funnelled debriefing procedure.**

As suggested by Bargh and Chartrand (2000, p. 259), participants completed a debriefing questionnaire to determine the extent to which they may have been aware of the purpose of the study (Appendix B). Participants’ responses were categorised according to their responses to the questions as *Completely unaware* (0), *Suspect tasks were related but unaware of how* (1), *Aware of some relationship between tasks but not the nature of the study* (2), *Aware of the relationship between tasks – some suspicion of nature of the study.* (3), or *Aware of the nature of the prime and the study* (4).

Participants returned for the second session two weeks after the first session to complete the temporal discounting measure only. After the second session participants were fully debriefed on the nature and purpose of the study. The study was approved by the University’s Ethics in Human Research Committee.

**Results**

There were no significant between-group age or education differences. At debriefing, one participant in each group reported a suspicion that the scrambled sentence task was a ‘primer’ of some kind, but did not speculate on what the study was

\textsuperscript{18} According to Vickrey (1961), asking the highest bidder to pay the amount of the second highest bid encourages bidders to bid what the delayed item is really worth to them because it ensures the bidder will make a small profit should they win the auction. Ambit bids are discouraged because of the possibility that the second highest bid may also be higher than the winning bidder wished to pay.
about or how one task may have affected the other. As the results were not sensitive to
their inclusion, we report all participant data here.

In order to avoid artefactual biases produced by analysing aggregate bidding data
(Kirby & Santiesteban, 2003), discounting rates were calculated for participants
separately. Discounting rates were calculated using Area Under the Curve analysis
(AUC; Beck & Triplett, 2009; Myerson, Green, & Warusawitharana, 2001; Ohmura,
Takahashi, Kitamura, & Wehr, 2006), employing the trapezoid summation method
below;

$$\sum (x_2 - x_1) \left[ \frac{(y_2 + y_1)}{2} \right] \quad (1)$$

(Myerson et al., 2001, p. 240).

The data were also analysed using temporal discounting estimates based on
Mazur’s (1987) hyperbolic model (equation 2) and an exponential model (equation 3;
Kirby, 1997, p. 54) of temporal discounting:

$$V = \frac{A}{(1 + AD)} \quad (2: \text{Hyperbolic model})$$
$$V = Ae^{kD} \quad (3: \text{Exponential model})$$

In the equations above, $V$ is the present value of delayed reward ‘$A$’, and ‘$D$’
represents units of delay. Solving for ‘$k$’ provides the estimate of temporal discounting.
Iterative non-linear regression demonstrated that the hyperbolic model provided a better
fit with participant data than did the exponential model (the discounting parameter
estimate was accompanied by a lower residual mean squared error term). This result is
consistent with previous empirical observations of human and animal discounting; thus,
hyperbolic model estimates are reported below.

The primed and control group data were not normally distributed for the AUC or
model-based analyses, violating the assumptions of parametric analyses. Therefore,
non-parametric statistics are reported below. Descriptive statistics for AUC and hyperbolic model-based estimates of discounting rates are presented in tables 1 and 2 respectively.

**Area Under the Curve (AUC) Analyses**

Obtained discounting rates were higher for the small amount ($9.90) than the large one ($29.90) for the control (Wilcoxon Signed Rank test, $z = 3.85, p < .001, r = .86$) as well as the priming group ($z = 4.31, p < .001, r = .86$), indicating a large magnitude effect. AUC scores (patience) increased as a function of age ($r_z (44) = .44, p = .002$) and educational attainment ($r_z (44) = .40, p = .006$), a finding that is consistent with the relevant literature.

<table>
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<th>Time two</th>
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<td>$9.90$</td>
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<td>Total</td>
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<td>M (SE)</td>
<td>Md</td>
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<tr>
<td>Fair prime</td>
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<td>.34 (.05)</td>
<td>.34</td>
<td>.43 (.05)</td>
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<tr>
<td>Control group</td>
<td></td>
<td>.32</td>
<td>.36 (.05)</td>
<td>.53</td>
<td>.52 (.05)</td>
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† Contrary to model-based temporal discounting estimates, lower ‘Area under the Curve’ coefficients denote lower ‘patience’ or higher impulsivity.

Median scores for temporal discounting rates consistently trended in the opposite direction to the stated hypothesis, particularly for the $29.90 and total discounting rate estimates (Table 1). Mann-Whitney U tests did not detect significant between group differences. However, a two-tailed Wilcoxon Signed Rank test of repeated measures effects detected that temporal discounting rates were significantly higher after the priming task than without priming, but only for the ‘Fair’ condition ($z_{9.90} = 2.53, p = .012$ & $z_{\text{TOTAL}} = 2.45, p = .014$, with medium to large effects sizes, $r = .51$ and $r = .49$, respectively). There were no significant differences for the control group.
Hyperbolic Model-Based Estimates

Magnitude effects were also detected with hyperbolic model-based iterations, although effect sizes were slightly smaller. The smaller amount was discounted more than the large amount for the control ($z = 3.26, p < .001, r = .73$) and the primed groups ($z = 3.80, p < .001, r = .76$). Discounting (impulsivity) also decreased as a function of greater age ($r_z(18) = -.54, p = .01$) as well as education ($r_z(18) = -.52, p = .02$) for the control group. Age effects were detected for the primed group ($r_z(24) = -.42, p = .04$), but education effects were not ($r_z(24) = -.35, ns$).

<table>
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<tr>
<th>Table 2</th>
<th>Median and Mean Scores for Hyperbolic Temporal Discounting Estimates at Times One and Two for Primed and Control Groups (Standard Errors in Parentheses). †</th>
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<td>$9.90$</td>
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<td>Fair prime</td>
<td>26</td>
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<tr>
<td>Control group</td>
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</table>

† Higher point estimates denote higher impulsivity.

As with the AUC analyses, Mann-Whitney U tests detected no significant between group differences. Unlike the AUC analyses, priming group differences between times one and two did not reach significance for the $29.90$ auctions ($z = 1.95, p = .05$), but were significant for total discounting rates, $z = 2.20, p = .03$, with a small/medium effect size ($r = .39$). There were no within group differences for the control group. The difference between the AUC and model-based results may be accounted for by the fact that Area Under the Curve estimates of discounting do not include the residual error (RMSE) inherent in model-based iterations, making them more sensitive to subtle experimental manipulations (Beck & Triplett, 2009; Harrison & McKay, 2012).
Discussion

Within-subject effects indicated that—contrary to our hypothesis that moral cues would reduce temporal discounting—priming with secular moral concepts increased temporal discounting rates while priming with neutral phrases did not. As it has been demonstrated that secular moral and religious primes produce similar effects (Pichon et al., 2007; Shariff & Norenzayan, 2007), there are grounds to speculate on how these unexpected increases in discounting after exposure to moral primes might be explained.

Benjamin, Choi, and Fisher (2010) had participants complete Shariff and Norenzayan’s (2007) religious word primes before completing a temporal discounting measure. While they concluded there were no significant effects, for all but one of the six primed groups point estimates of temporal discounting (TD) rates were higher than for the control group. Two design characteristics suggest the possibility of a type 2 error. First, Benjamin et al. (2010) used a between-subjects design. As TD rates are highly variable between subjects (Frederick, Loewenstein, & O'Donoghue, 2003, p. 14), our repeated measures design may be more sensitive to small experimental effects. Second, their study used a forced binary choice method of assessing TD rates (‘$5 now or $8 in a week?’), the results of which were analysed using model-based estimates. Beck and Triplett (2009, p. 354) and Harrison and McKay (2012) argue that the residual error inherent in model-based estimates makes them less sensitive to experimental manipulations than atheoretically derived analyses. Moreover, equivalent present value (EPV) procedures reduce the potential floor, ceiling and memory effects that are more likely in the brief choice procedure used in Benjamin et al. (2010). The present study addressed these issues by using an equivalent present value method, atheoretical analyses and within-subjects comparisons.
If activation of moral and religious concepts increases temporal discounting, a reconsideration of the role of impulsivity in non-punitive pro-social behaviours may be called for. What follows is offered in a speculative vein with a view to stimulating further research.

Many daily activities are rewarding because they contribute to satisfying long term (or ‘ultimate’) goals. Sex is pleasurable because that causes one to expend resources seeking it out. The same may be said of many activities that ensure our genetic survival. They are pursued not because of the ultimate goal, but for the experience of reward in the present (West, El Mouden, & Gardner, 2011). Recent work on prosociality and reputation enhancement indicate that morally laudable behaviour (e.g. sharing) could be added to the list of behaviours that are immediately rewarding and provide long term individual fitness gains. Dunn, Aknin and Norton (2008) report that participants who were directed to spend money on others reported increased wellbeing afterwards, while those that were directed to spend it on themselves showed no such increase. The greater the increase in happiness, the more likely they were to spend money on others again (Aknin, Dunn, & Norton, 2012).

Behaviour that signals to others and oneself that we are ‘good people’ is rewarding. Izuma, Saito and Sadato (2008; 2009) found that neurological imaging of responses—particularly in the striatum—to positive news about one’s reputation overlapped considerably with responses to material rewards like money. Thus, when moral concepts are activated, there exists the prospect of a potent social reward\(^{19}\). In this respect, the impetus to prosocial behaviour differs from other situations that appear to require self-control. It may require self-control to keep a dental appointment.

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\(^{19}\) Conversely, there also exists the threat of negative social self/other evaluation.
enduring pain for later benefit. Prosocial behaviour on the other hand may represent an immediately rewarding experience that few dental procedures offer.

The prospect of reward is arousing. Wilson and Daly (2003) found that after being presented with pictures of attractive women, male participants displayed higher temporal discounting rates compared to controls. Wilson and Daly reasoned that increased impulsivity resulted from mild arousal at the prospect of sexual opportunity. Their interpretation is supported by findings that presentation of contextual cues normally associated with rewards increases temporal discounting. For example, cueing prospective financial rewards increased discounting rates in gamblers (Odum & Baumann, 2010, p. 45). Increases in impulsivity on exposure to moral cues may encourage individuals to take an immediate social reward, encouraging ‘one-upmanship’ in terms of cooperation or generosity, increasing average levels of cooperation in larger groups. To summarise, the activation of moral concepts may trigger the prospect of a rewarding experience; an increase in social reputation. Cues signalling the presence of a potential reward appear to increase temporal discounting rates.

However, our results are difficult reconcile with Curry et al. (2008) from a theoretical perspective. If low trait impulsivity predicts cooperative behaviour, it would be counterintuitive to argue that primes/cues that lead to cooperative behaviour should do so via increased discounting. To make matters more complex, Harrison and McKay (Chapter 4) found that higher temporal discounting rates predicted greater endorsement of the Fairness and Care foundations on the Moral Foundations Questionnaire. Words from the Fairness foundation were used as primes in the present study.

If our account of the present results is correct, then participants in Curry et al.'s (2008) study were presented with two options. On one hand, participants could enjoy an
Immediate social reward resulting from making a fair contribution to the group, with a small financial return; on the other hand, they could take a larger financial reward by contributing nothing at all. It appears that those with lower TD rates more frequently opted for a greater social reward, committing more funds to the public goods game. Whether temporarily increased discounting rates facilitated this preference for social rewards over financial ones is not clear.

Activation of moral concepts may also result in heightened sensitivity to observation. This explanation is of course compatible with reputation enhancement, and has the advantage of congruence with Bourrat, Baumard and McKay (2011), who found that observation cues increased condemnation of moral transgressions. Crockett et al. (2010) found that increasing impulsivity increased rejection of unfair offers. While these studies concerned punishment, the present study is the first, as far as we are aware, to attempt to make a causal link between activation of positive secular moral concepts and changes to temporal discounting.

While Mazar, Amir and Ariely (2008) found that unobserved participants were more likely to cheat on a test, they noted that even without being observed, participants were still careful to maintain their ‘self-concept’ as moral people by not cheating too much. Mazar et al. (2008) found that participants’ cheating was restricted to only 6.7% of the total amount it was possible to defraud the experimenter (p. 13; experiment 1). This is relevant to our present findings. In the present study, discounting rates for the small amount ($9.90) were not sensitive to the moral priming condition, while discounting rates for the larger amount ($29.90) were. Perhaps small monetary amounts fall outside individuals’ moral regard, and were therefore unaffected by the priming of moral concepts. One might imagine a far greater sense of urgency to reciprocate if a friend covered a $100 dinner cost than if they offered $5 to cover a
coffee bill. There may be a threshold based on how likely the amount is likely to be missed. Whatever the case, the results are interesting in light of previous work and therefore worth further exploration. For instance it would be of interest to determine whether this priming effect is replicable not only for money but other goods like drugs or food as well.

The present results indicate that compliance with moral norms may not depend on the reduction of impulsivity; indeed the activation of moral concepts appears to have increased it. Many readers will have experienced an impulse to give money to a beggar before second guessing themselves with cooler deliberation – a case of self-control overriding a moral impulse. This explanation has received recent empirical support. Rand, Green and Nowak (2012) found in a raft of economic games that participants who had more time to reflect on their decisions tended to be less cooperative than those who reached similar decisions more rapidly, a finding that hints at the intuitive—even impulsive—aspects of human cooperation. Moreover, human societies consist of people who generally adhere to internalised social norms (e.g. waiting our turn), to the extent that violations meet with censure. So it does not seem very parsimonious to imagine that the restraint of impulse is required whenever one is faced with a queue, honesty box or any other common social exchange (Haidt & Kesebir, 2008). It is far simpler that a modicum of morally correct behaviour should feel rewarding, making it the ‘default’ response which can be renegotiated when need or opportunity arise. Of course, the content and relative importance of social norms (reciprocity versus loyalty for example) is largely influenced by one’s cultural milieu (Graham, Haidt, & Nosek, 2009; Haidt & Joseph, 2006; Henrich et al., 2001).

The present study has some design features worth mentioning. First, the interval between sessions was two weeks, long for an experimental study. Session one took
place during university teaching session while the second took place during semester break. While changes in circumstance may have introduced variability to observed discounting rates, there is have no reason to believe this should have affected one group more than the other. The long interval allowed ample time for the priming effect to dissipate, and for participants to forget bidding strategies they might have used. Changes in circumstance would have, if anything, made priming effects harder to detect by increasing the impact of extraneous variables in the data.

Another feature of the study concerns relatively short delays compared to other studies (Beck & Triplett, 2009, measured delays up to 5 years). This was a necessary constraint as winners were asked to wait for their money. When using Area Under the Curve (AUC) analysis, longer delay intervals would have a disproportionate impact on the area under the curve. Thus, comparing AUC data for longer intervals with AUC data in the present study should account for this, and do so with caution.

The primes were restricted to only one of the five moral foundations discussed by Graham et al., (2011); namely the concern for fairness. The ‘Fair’ foundation was likely to be germane to decisions about money since money is, essentially, formalised reciprocity (Dawkins, 1976; Trivers, 1971). Further, Henrich et al. (2010) demonstrated that western industrialised societies value equity and fairness more than many other cultures, sounding a note of caution in terms of generalising the present findings beyond the population from which the samples was drawn.

The present study demonstrated that supraliminal activation with positive secular moral concepts may increase impulsivity. We have accounted for this effect with the suggestion that the activation of positive moral concepts may result in arousal at the prospect of reward. Reputational benefits may be the ultimate result of this immediate
appeal. If this is the case, then the cognitive and affective mechanisms that drive this intrinsic reward require explanation.

It has also been demonstrated that secular moral primes increase pro-social intentions (Pichon et al., 2007) and altruistic behaviour (Shariff & Norenzayan, 2007). While secular primes appear to increase pro-sociality, altruism and impulsivity, it has not been demonstrated that impulsivity mediates the relationship between moral concepts and subsequent pro-social behaviours. Pending successful replication of the present result, detection of such a mediating effect would be congruent with our explanation and would be a welcome avenue for further study.

The shopkeeper described in the opening vignette represents an extreme example of moral impulsivity, but it is also possible our better impulses lead us to behave cooperatively in more prosaic circumstances. This may be a more parsimonious explanation of pro-social conduct, than the oft proposed intra-personal struggle, where one has a preference which must be overcome by an act of moral ‘self-control’.
References


Chapter 6

Do Religious and Moral Concepts Influence the Ability to Delay Gratification? A Priming Study.

A version of this chapter is currently in press in the journal, Behavioral and Brain Sciences.

Abstract

Rounding, Lee, Jacobsen and Ji (2012) recently reported that priming with religious concepts increases the ability to delay gratification, a result that implies a decrease in temporal discounting rates for money. Although priming with religious or secular moral items tend to produce similar behavioural effects, Harrison and McKay (Chapter 5) detected within subject increases in temporal discounting rates following priming with secular moral concepts. In order to resolve this apparent contradiction and replicate the latter study, sixty-nine participants were allocated to a religious, secular moral (Fairness) or neutral implicit priming condition. Temporal discounting rates were estimated for each participant using an ‘equivalent present value’ (EPV) procedure immediately prior to, and following, the sentence unscrambling primes. While the oft-cited reward magnitude effects were detected, no effects for the priming manipulations were detected. Technical and theoretical accounts for the present results are discussed, including the possibility that the activation of social goals comes into conflict with financial ones in some experimental contexts.
Do Religious and Moral Concepts Really Influence the Ability to Delay Gratification? A Priming Study.

Modern societies present individuals with continuous conflicts between their immediate desires and the needs of others in their community. While factors such as direct reciprocity and kinship explain cooperation in small groups, it does not explain cooperation in much larger communities (Henrich et al., 2010). There is growing evidence that religious and moral codes provide the cultural means to allow very large communities to flourish. The greater the size of the group, the more prevalent a moral code appears to be. For example, Henrich et al. (2010) found that the prevalence of market exchanges—measured as calories purchased per capita—and the size of the community, positively predicted the presence of fairness norms and the punishment of defection, respectively. Religious and moral codes have been credited with the power to restrain impulsivity (Baumeister, Bauer, & Lloyd, 2010; Baumeister & Exline, 1999) and reduce selfishness making ‘social life possible’ (Graham, Haidt, & Rimm-Kaufman, 2008, p. 21).

Implicit priming of religious and secular moral concepts has been observed to increase prosocial sharing (Shariff & Norenzayan, 2007), and intentions to perform prosocial behaviours (Pichon, Boccato, & Saroglou, 2007). Religious priming has also increased altruistic punishment for people who affirm their religiosity by giving funds to religious organisations (McKay, Efferson, Whitehouse, & Fehr, 2011). The similar behavioural effects indicate there is likely to be some representational/conceptual overlap between religious and secular moral schemas; the activation of one spreading to the other (Collins & Loftus, 1975). Alternatively, religious concepts may make reputation salient by activating the notion of a supernatural watcher, increasing the
likelihood that participants would behave in accord with learned social mores (Shariff & Norenzayan, 2007).

However, the cognitive and/or affective processes that must occur between exposure to moral or religious concepts and the observed behavioural changes are not well understood. Progressing this issue, Rounding et al. (2012) reasoned that religious priming allows greater prosocial behaviour by replenishing the capacity for self-control. The authors found that participants primed with religious words drank unsavoury liquids (Study One), delayed gratification (Study Two), persisted with unsolvable puzzles (Study Three) and suppressed redundant responses on a Stroop test (Study Four) to a greater extent than relevant controls. In Study 4, there were no differences between groups primed with religious and secular moral words. This prompted the authors to recommend research on the behavioural effect of secular moral concepts (p. 13), a recommendation answered by Chapter 5 and the present study. The present study altered Rounding et al.'s second experiment to include an explicit measure of temporal discounting that was relatively opaque in terms of social desirability, and attempted to replicate the findings from Chapter 5; namely that exposure to secular moral primes increases temporal discounting rates.

Temporal discounting refers to the tendency for animals and people to ascribe lesser value to a reward or consequence as a function of delay until it occurs (Ainslie, 2002; Loewenstein, Read, & Baumeister, 2003). Changes to temporal discounting (TD) rates as further delays are added are generally assumed to be additive and hyperbolic (Ainslie, 2001; Kirby, 2006; Kirby & Santiesteban, 2003; Rachlin, 2006; but see Read, 2001; Read & Roelofsma, 2003 for an opposing view); this means the introduction of the first delay causes a precipitous drop in subjective value; the addition of subsequent delays lower the subjective value by progressively smaller increments.
Temporal discounting is a reliable, indirect measure of self-control (Reynolds, Ortengren, Richards & de Wit, 2006).

The study reported in Chapter 5 primed participants with secular moral concepts—such as ‘equality’ and ‘fair’—drawn from the ‘Fair’ entry of Graham and Haidt’s (2009) Moral Foundations Dictionary. Within subjects increases in temporal discounting rates were detected for the primed group but not the control group. This is incongruent with Rouding et al.’s (2012) second study where, after priming, participants were given two options - return tomorrow and collect a $5 honorarium, or return in a week and collect $6. Participants primed with religion were more likely than controls to wait the extra six days. Rounding and colleagues’ (2012) conclusion that religious priming had replenished self-control resources assumes that control participants were unable (rather than merely unmotivated) to wait. The implication is that participants who waited had discounted the value of the delayed $6 less than those who did not wait.

The trouble is that Rouding and colleagues’ (2012, study 2) ‘resource refuelling’ interpretation rests on the assumption that coming back in a week for one extra dollar is the more valuable option, if only the participants could muster the self-control to wait. However, the implied discounting rate of such an assumption is at odds with much of the temporal discounting research. Objectively, the later amount is more valuable, but subjectively it most probably is not when accounting for the delay. By applying Mazur’s (1987) hyperbolic temporal discounting formula (equation 2) to the decision presented by Rouding et al. (2012; study 2), it becomes evident that in order to prefer $6 in a week, over $5 the following day, one would require an exceptionally low discounting rate (discounting rate $k \leq 0.0286$). Temporal discounting studies returning such small discounting estimates generally concern amounts exceeding $1000
Humans reliably show magnitude effects when discounting; the size of the reward has an inverse relationship with discounting. Thus, smaller amounts usually elicit much higher discounting (impatience) estimates (Green, Myerson, & McFadden, 1997; Madden & Bickel, 2010; Ohmura, Takahashi, Kitamura, & Wehr, 2006).

Nevertheless, amounts twice ($10) or four times ($20) larger than the amount at issue in Rounding et al. (2012) are routinely discounted at rates five times greater than the rate implied by Rounding and colleagues’ results (Harrison & McKay, 2012, \( k(9.90) = .124 - .132, k(19.90) = .101 - .119 \); Kirby & Santiesteban, 2003, \( k(10) = .089 - .095, k(20) = .071 - .091 \)). If Rounding and colleagues’ prime reduced temporal discounting—making the later amount appear more valuable than the sooner amount—it must have reduced it from \( k \approx .09 \) (based on the studies cited above) to \( k < .03 \), a reduction of about two thirds. The prospect of such a very large effect is worth a direct test of the effect of religious primes on an explicit measure of temporal discounting. If temporal discounting rates for money are not reduced by religious primes to the extent described above, then Rounding and colleagues’ finding would demand an explanation that does not depend upon an increase in self-control resources, since there is no pecuniary incentive to wait.

**The Activation of Reputational Goals**

Ainslie (2009) makes the point that people are able to resist small immediate temptations by cognitively grouping long-term rewards together so that their value overwhelms the value of the small immediate rewards. For example, an anticipated improvement in health may be bundled with an increase in self-esteem at the prospect of achieving a difficult goal whenever one resists the urge to smoke cigarettes. It has
been demonstrated experimentally that the value of a series of rewards are additive (Kirby, 2006). For the decider, responses to small, immediate temptations become a test case; informational inputs into forecasts on the likelihood of resisting future temptation (Prelec & Bodner, 2003). Failures erode confidence in one’s ability to achieve long-term goals and thus encourage further violations. Conversely, staying the course in small matters increases the perceived likelihood that resistance to future temptation and longer-term rewards are achievable. Thus, the longer-term goal in Rounding et al.’s (2012) second study included $6, plus the value of what the decision maker believes waiting for the money says about them (Ainslie, 2009). It is possible that religious priming in Rounding and colleagues’ second study increased the salience of one’s ideal ‘self-concept’, facilitating the decision to wait.

A compatible explanation concerns signalling of one’s credentials as a worthy member of a group, a trading partner or mate (Gintis, Smith, & Bowles, 2001). The one shot decision in Rounding et al.’s (2012) study was set in a context of social exchange; payment for participation in the study. The decision presented an opportunity to signal that they are more patient than their fellow participants; an opportunity that is more likely to be taken by participants for whom social reputation was made salient by religious priming. It is likely that participants were not rendered more able to wait by religious concepts; instead, they were more motivated to wait, as a means to signal their good qualities. This account has the advantage of congruence with Shariff and Norenzayan’s (2007) conclusion that religious primes activate reputational, rather than financial goals.

Shariff and Norenzayan (2007) presented participants with 10 one-dollar coins, giving them the opportunity to donate some to an anonymous recipient. Participants primed with religious concepts donated more coins than control participants. Shariff
and Norenzayan argued their religious prime “aroused an imagined presence of supernatural watchers… this sense of being watched then activates[d] reputational concerns” (pp. 807-8). Subsequent studies have tested this contention, finding that religious concepts increase socially desirable responding (Gervais & Norenzayan, 2012). Rounding et al. discuss a motivational interpretation, but appear not to appreciate the tension between this and the resource account of self-control (Baumeister, Muraven & Tice, 2000) they appear to favour.

**Are social rewards immediate or delayed?**

Whether religious priming reduces discounting rates or not, both accounts are incongruent with the results of Chapter 5; that discounting rates increased after priming with secular moral concepts. Recursive self-prediction (Ainslie, 2009) and costly signalling (Gintis et al., 2001) both rely on the assumption of additive increases in the subjective value of the *later* reward (money + the value of reputational increase with oneself or others), tipping the actor’s decision in favour of accepting a delayed reward. Presumably, the religious or secular moral primes raise the salience of one’s reputation by heightening the sense of being observed (Shariff & Norenzayan, 2007).

But the pursuit of reputation enhancement may be emotionally rewarding in the present in the same way that a payslip feels rewarding because it signals future material gain. Similarly, sex is pursued because of its proximal reward; sex is pleasurable, and the pursuit of pleasure supports the ultimate goal, reproduction. Behaviours which signal one’s moral/pro-social credentials might have similar characteristics.

A test of this idea involves a key feature of any behaviour that has come to be pursued because of its proximal reward rather than its ultimate utility; the drive to perform the behaviour even when the ultimate function is unlikely to be served. People continue to have sex though they are—often deliberately—infertile; they continue to eat
high calorie diets in spite of the fact that excessive fat stores impair health. A similar characteristic should be observed for moral/pro-social behaviours. Even in the absence of any expectation that the behaviour will provide a benefit, it should still be preferred. There is some reason to suspect this is the case.

Turillo, Folger, Lavelle, Umpress, and Gee (2002) modified a series of three player ‘altruistic punishment and reward’ games (Kahneman, Knetsch, & Thaler, 1986; Thaler, 2000) so that participants’ decisions remained anonymous to other players and researchers. Participants were aware that those they rewarded/punished would remain ignorant of the fact. Turillo et al., (2002) found that participants overwhelmingly elected to sacrifice some of their stake to reward another player who had divided the $20 endowment evenly, even when no social benefit could accrue. We may conclude that even where material and reputation benefits are set aside, some—if not as much—pro-social behaviour often remains.

The possibility that signalling one’s personal credentials is rewarding in the present allows us to view the decision made by participants in Rounding and colleagues’ (2012) second study in a different light. Participants could take a social reward with no delay by signalling their good qualities (plus collect $6 in one week), or go away now with nothing and come back tomorrow for $5. As discussed earlier, a central point of hyperbolic discounting models is that any initial delay substantially reduces the present value of a reward. Thus, Rounding and colleagues’ design (which correctly, kept transaction costs equivalent) may have encouraged participants to take the immediate social reward - signalling their good attributes to the experimenter - rather than leave empty handed, to return in one day for their $5 honorarium. This would be especially likely if the primes had raised temporal discounting rates, lowering the value of the five dollars in a day compared to an immediate social reward. Thus,
despite the appearance of reduced temporal discounting in Rounding et al.'s study, their result could actually be explained by all three possible outcomes:

1. Religious primes reduce temporal discounting. Participants primed with religious concepts had increased patience, compared to controls. Therefore, $6 in one week was more valuable to them than $5 in one day, while the reverse was the case for control participants. This account is implied in Rounding et al.; social goals need play no role.

2. Religious primes increase temporal discounting rates. Participants primed with religious concepts were more impatient, and thus valued the immediate social reward of improved reputation (plus $6 in one week) over going away empty handed now and returning tomorrow for $5. This account would be congruent with Chapter 5 if, as the literature suggests, moral and religious concepts produce similar behavioural effects. In this account, changes to discounting rates and social goals play a role.

3. Religious primes do not affect temporal discounting rates, but do affect salience of social goals. Participants primed with religious concepts valued $5 in one day over $6 in one week, but instead elected to signal their patience to potential or actual observers in order to enhance their reputation. This account would be most congruent with Shariff and Norenzayan (2007), given that their participants gave extra money to others, at cost to themselves, after being primed with religious concepts.

We favoured the second possibility in light of a corpus of research indicates that cues of potential reward, like images of beautiful women (Wilson & Daly, 2003), or gambling environments (Dixon, Jacobs, & Sanders, 2006) raise participants’ discounting rates.

In Rounding and colleagues’ second study; it was obvious that electing to wait would make participants appear more patient. The socially desirable option was to
elect to wait, which is what participants who had been primed with religion were more inclined to do. In contrast, Chapter 5 used a temporal discounting measure that was opaque in this respect; it was difficult to discern the socially desirable response. Thus, measurement of temporal discounting rates did not conflict with the desire to signal one’s good qualities, as it did in Rounding et al. (2012; Study Two). In short, the bids reflected an increase in general rates of temporal discounting produced by the prospect of social reward. It is possible that Shariff and Norenzayans’ (2007) religious primes, under the same conditions, may also raise discounting rates.

In order to progress the issue, the present work included a secular moral prime, Shariff and Norenzayan’s (2007) religious prime, and a neutral condition. The priming task was preceded—and followed—by 15 one bid, second price auctions (Vickrey, 1961) for delayed amounts of money. The bids were used to calculate temporal discounting rates for each participant before and after the priming task. If primes trigger anticipation of an immediate social reward the moral and religious prime groups would display increased discounting rates at time two compared to time one.

On the other hand, if priming religious concepts does increase self-control as suggested by Rounding et al. (2012), it would be reflected by a post-priming decrease in temporal discounting rates for the religion group. A replication of Harrison and McKay’s (Chapter 5) increase in discounting rates in response to moral primes in the same study would indicate that moral and religious concepts affect temporal discounting rates very differently. Such a finding would be difficult to explain in light of experimental work showing that religious and moral primes lead to similar behavioural changes (Pichon et al., 2007; Rounding et al., 2012; Shariff & Norenzayan, 2007).
Method

Participants

Sixty-nine (20 male & 49 female) staff and students at a regional Australian University, with a mean age of 23.68 years (SD = 8.91) participated. One participant had completed high school only, 63 were undergraduate students, three were postgraduate students and two had completed postgraduate studies. Thirty-one participants described themselves as agnostic or atheist, thirty-one as Christian, one as Buddhist and another as Muslim. Five participants nominated their religion as ‘other’.

Materials and Procedure

Sessions were conducted in groups of two to eight participants. Participants were informed prior to the session that they were required to bring AUD$30.00 in order to bid in a series of auctions. One volunteer declined to participate as a result of this requirement. Participants were seated in front of a Personal Computer (PC). Next to each terminal was an unmarked folder with the consent form uppermost. The folder contained the priming task, religion and religiosity questionnaire as well as a funnelled prime awareness questionnaire - as suggested by Bargh and Chartrand (2000).

Temporal (delay) discounting measure.

In two sets of 15 ‘one shot’ Second Price auctions (one prior to, and one following the priming task) participants were asked to nominate an amount they were prepared to pay for delayed sums of money so that they felt they would just ‘break even’ (Vickrey, 1961). For example, participants were asked how much they would pay today, for $29.90 to be made available in 35 days. Trials were presented using the Dreamweaver application. Two amounts of money were presented (AUD$9.90 & $29.90), alternating on each trial. Delays of 1, 3, 5, 11, 19, 27, 35 and 43 days (for $9.90) and 2, 4, 7, 15, 23, 31 and 39 days (for $29.90) were presented in randomised
order so that there was no correlation between delay amount and the order of the auctions. All participants received the auctions in the same order.

After entering a bid, participants were directed to a second screen where they were asked whether they would like to ‘keep their money’, ‘wait for the delayed money’ or whether those options ‘feel about the same to me’. This measure was intended to reinforce the instruction that participants should bid to ‘break even’ and provided an opportunity to fine tune their bid, raising the accuracy of obtained indifference points (Kirby & Santiesteban, 2003). If the ‘keep money’ option was selected, the participant was instructed to reduce their bid, if they selected the ‘wait’ option they were instructed to increase it (by $0.10 increments). This process could be repeated until the participant selected the ‘feels about the same’ option, at which point their final bid was recorded. Three practice trials were provided during which participants were encouraged to ask questions about the procedure.

After participants had completed fifteen auctions, they were asked to complete a pen and paper ‘filler’ task (the sentence unscramble priming task) while the experimenter prepared the database for the second round of auctions. On completing the priming task participants immediately completed a further 15 auctions. In the second round, delays nominated for the small amount ($9.90) in the first round were allocated to the large amount ($29.90) and vice versa. For example, the first round included ‘$9.90 in one day’ and ‘$29.90 in two days’, so the second round presented ‘$9.90 in two days’ and ‘$29.90 in one day’ so that no items would be repeated, eliminating explicit memory effects. As this method splits a well-documented temporal discounting method (Harrison & McKay, 2012; Kirby & Santiesteban, 2003) into two discrete tests, systematic variation between the halves needed to be ruled out. Analysis of data from Harrison and McKay (2012) demonstrated that this method returned
temporal discounting rates that were statistically equivalent to each other and to the rates returned by all thirty auctions.20

At the conclusion of the auctions, a number between 1 and 30 was selected at random, determining which round would be paid out. The highest bidder in that auction was invited to complete the transaction by paying the amount placed by the second highest bidder (Vickrey, 1961)21. To control transaction costs regardless of delay the money was received by presenting the receipt at the Psychology School office once the nominated time delay (1 – 43 days) had elapsed.

**Priming instruments.**

Folders containing the religious, moral priming or neutral priming papers were shuffled and placed by an assistant so that during sessions the experimenter was blind to condition. The scrambled sentence task is widely employed in supraliminal priming research (Bargh & Chartrand, 2000, 2005; Shariff & Norenzayan, 2007). Participants were given 10 sets of five words, from which they were required to construct meaningful four word sentences, omitting one word. The religion condition was identical to that used in Shariff and Norenzayan (2007) and Rounding et al. (2012). In the moral condition, the instrument used in Harrison and McKay (Chapter 5) was shortened to match the religion primes used by Rounding et al. (2012). Five of the 10 sets contained words intended to prime the moral concern of fairness using words from the Moral Foundations Dictionary ('Fair virtue' entry; Graham & Haidt, 2009). Observing Randolph-Seng and Nielsens’s (2008) recommendations, the moral connotations of the words were obscured (e.g. ‘Acacias are drought tolerant’) as far as

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20 Statistical equivalence between the measures was determined using the 'two one sided t-test' (TOST) method suggested by Schuirmann (1987) and described in Stegner, Bostrom and Greenfield (1996). Equivalence region was set at 0.2 (total).

21 According to Vickrey (1961), asking the highest bidder to pay the amount of the second highest bid encourages bidders to bid what the delayed item is really worth to them because it ensures the bidder will make a small profit should they win the auction. Ambit bids are irrational because of the possibility that the second highest bid may also be higher than the winning bidder wished to pay.
practicable. The neutral condition contained 10 word sets without moral or religious content. Participants were seated so that they could not see whether priming tasks differed. On completing the task, participants were instructed to proceed with the second set of auctions without delay. The priming instruments may be inspected at Appendix D.

Demographics and religiosity.

After the second set of auctions, participants were asked for demographic details including religious affiliation and religiosity. Recent research indicates that frequency of contact with one's religious community has a greater effect on behaviour than affiliation, prayer or strength of belief (Bloom, 2012; Malhotra, 2010). Thus, participants were asked how frequently they attended gatherings of their religious community in the preceding year, on a scale from '0' (Not Applicable) to '4' (> Ten Times). Participants also self-reported strength of religious affiliation on a scale from '1' (Non-practising) to '4' (Devout).

Funnelled debriefing procedure.

As suggested by Bargh and Chartrand (2000, p. 259), participants completed a debriefing questionnaire to determine the extent to which they may have been aware of the purpose of the study. Participants’ responses were categorised according to their responses to the questions as ‘Completely unaware (0), ‘Suspect tasks were related but unaware of how’ (1), ‘Aware of some relationship between tasks but not the nature of the study’ (2), ‘Aware of the relationship between tasks – some suspicion of nature of the study.’ (3), or ‘Aware of the nature of the prime and the study’ (4).

Results

Demographic data for each group are presented in Table 1. Data were excluded for four participants, two as a result of response set (participants placed the same bid
regardless of delay) and two because of software malfunction during sessions. No
between group differences were detected for age or education. A one-way ANOVA
indicated significant between group differences for contact with one’s religious
community. Post-hoc (Tukey’s) testing indicated that participants in the secular moral
(Fair) group reported greater contact with their religious community than the control
(Neutral) condition, \(F(2, 62) = 3.193, p = .048, d = .083\). However, the effect was
small. Neither condition differed from the Religion condition on this measure.

Table 1
Mean Scores (SD in Parentheses) for Age and Religiosity. Frequency Data for Education,
Gender and Religion by Condition.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Moral</th>
<th>Religious</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>23</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>22.04 (8.03)</td>
<td>26.24 (11.43)</td>
<td>22.44 (6.00)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Females</td>
<td>19</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed High School</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Undergraduate Student</td>
<td>22</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Postgraduate Student</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Religious affiliation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atheist</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Agnostic</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Christian</td>
<td>9</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Muslim</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Buddhist</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Religiosity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious observance</td>
<td>.91  (1.00)</td>
<td>1.10 (1.09)</td>
<td>1.00 (.97)</td>
</tr>
<tr>
<td>Attendance at events</td>
<td>1.57 (1.04)</td>
<td>1.10 (1.04)</td>
<td>.83 (.71)</td>
</tr>
</tbody>
</table>

Following Kirby and Santiesteban (2003), we calculated discounting estimates
individually before aggregation for further analyses. Discounting rates were calculated
using Area Under the Curve analysis (AUC; Beck & Triplett, 2009; Myerson, Green, &
Warusawitharana, 2001; Ohmura et al., 2006), employing the trapezoid summation method below;

\[ \sum (x_2 - x_1) \left[ \frac{(y_2 + y_1)}{2} \right] \]  \hspace{1cm} (1)

(Myerson et al., 2001, p. 240)

The data were also analysed using temporal discounting estimates based on Mazur’s (1987) hyperbolic (equation 2) and an exponential model (equation 3; Kirby, 1997, p. 54) of temporal discounting, where \( V \) is the present value (the participants ‘bid’) of delayed reward ‘\( A \)’ (either \$9.90 or \$29.90), and ‘\( D \)’ represents the number of days until the money becomes available. Solving for ‘\( k \)’ provides the estimate of temporal discounting.

\[ V = \frac{A}{(1 + AD)} \] \hspace{1cm} (2: Hyperbolic model) \hspace{1cm} \[ V = Ae^{kD} \] \hspace{1cm} (3: Exponential model)

Iterative non-linear regression demonstrated that the hyperbolic model provided a better fit with participant data than the exponential model (i.e. the discounting parameter estimate was accompanied by a lower residual mean squared error term [RMSE]). Thus, only hyperbolic model estimates are reported below. The discounting estimate data were normally distributed for the AUC. However, consistent with much of the literature, hyperbolic model based estimates were skewed and kurtotic (Kirby, 1997; Kirby & Santiesteban, 2003; Kirby, Winston, & Santiesteban, 2005).

Logarithmic (base 10) transformation rendered the data suitable for parametric analyses.

Within subject comparisons determined that smaller amounts (\$9.90) were discounted more than the larger amounts (\$29.90) for time one (AUC; \( t(63) = 11.82, p < .001 \) & HYP; \( t(63) = 12.02, p < .001 \)) and time two (AUC; \( t(63) = 9.96, p < .001 \) & HYP; \( t(63) = 10.65, p < .001 \)). Such magnitude effects are consistent with the literature
(Kirby & Marakovic, 1996). Temporal discounting (TD) rates were negatively associated with age for the large amount at time two ($r(63) = .26, p = .04$) only. No education effects were detected.

Table 2
Median and Mean Scores for ‘Area Under the Curve’ (AUC) Temporal Discounting Estimates at Times One and Two for Primed and Control Groups (Standard Errors in parentheses).†

<table>
<thead>
<tr>
<th>Time one (pre-priming)</th>
<th>Time two (post-priming)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9.90$</td>
<td>$29.90$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
<tr>
<td>$Md$</td>
<td>$M$ (SE)</td>
</tr>
</tbody>
</table>

Fair  .35 .44 (.05) .63 .60 (.05) .46 .51 (.05) .41 .46 (.05) .66 .59 (.05) .49 .52 (.05)
Religion  .35 .35 (.04) .58 .55 (.04) .44 .43 (.04) .36 .36 (.04) .49 .51 (.05) .40 .43 (.04)
Neutral  .34 .36 (.05) .59 .54 (.06) .43 .43 (.05) .29 .34 (.05) .53 .51 (.06) .36 .41 (.05)

†Contrary to model based temporal discounting estimates, lower ‘Area Under the Curve’ coefficients denote lower ‘patience’ or higher impulsivity.

Analysis of between and within subject effects, using Split Plot Analysis of Variance (SPANOVA) detected no main effects for time or condition. Nor did simple inferential analyses (t-tests) detect within or between groups differences (all $p$ values > .33). The primes had no detectable effects on temporal discounting rates. Moreover, temporal discounting rates were not associated with self-reported religiosity, frequency of contact with one’s religious community or whether participants were theist, atheist or agnostic.
Table 3
Median and Mean Scores for Hyperbolic Temporal Discounting Estimates at Times One and Two for Primed and Control Groups (Standard Errors in Parentheses).

<table>
<thead>
<tr>
<th>Time one (pre-priming)</th>
<th>Time two (post-priming)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9.90</td>
<td>$29.90</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Md</th>
<th>M (SE)</th>
<th>Md</th>
<th>M (SE)</th>
<th>Md</th>
<th>M (SE)</th>
<th>Md</th>
<th>M (SE)</th>
<th>Md</th>
<th>M (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td>.17</td>
<td>.19 (.03)</td>
<td>.03</td>
<td>.08 (.02)</td>
<td>.08</td>
<td>.12 (.03)</td>
<td>.12</td>
<td>.20 (.05)</td>
<td>.03</td>
<td>.11 (.04)</td>
</tr>
<tr>
<td>Religious</td>
<td>.14</td>
<td>.36 (.13)</td>
<td>.05</td>
<td>.10 (.03)</td>
<td>.09</td>
<td>.16 (.04)</td>
<td>.16</td>
<td>.33 (.09)</td>
<td>.07</td>
<td>.12 (.03)</td>
</tr>
<tr>
<td>Neutral</td>
<td>.26</td>
<td>.61 (.24)</td>
<td>.05</td>
<td>.19 (.08)</td>
<td>.10</td>
<td>.32 (.13)</td>
<td>.37</td>
<td>.44 (.09)</td>
<td>.06</td>
<td>.33 (.18)</td>
</tr>
</tbody>
</table>

Discussion

As robust magnitude effects on discounting rates were detected, there is reason to believe that discounting rates were measured correctly. Nevertheless, our prediction that religious and moral primes may increase discounting rates was not supported by the data. We present some technical and theoretical speculations on the results below.

With respect to the failure to replicate the results from Chapter 5, there are three possible explanations.

The decrease in intervals between testing sessions, compared to Chapter 5, was designed to reduce the potential for participants’ circumstances to change in the interval—reducing statistical noise in the measurement of discounting rates. Changes in hunger, financial situation, and fatigue may all affect temporal discounting rates (Anderson & Revelle, 1994; Odum & Baumann, 2010). However, it is possible that the short inter-session interval produced an anchoring effect (Tversky & Kahneman, 1974). Even though no single trial was repeated, efforts to bid consistently may have proven more influential than the primes. This appears unlikely though, since Wilson and Daly (2003) detected changes to discounting rates using a very short retesting interval.
Second, noting that perceived unfairness raised discounting rates in Crockett, Clark, Liebermann, Tabibnia, and Robbins (2010), it may be that a single item (‘justice’) in the prime used in Chapter 5 may have produced the observed effects by activating the notion of moral transgression and punishment. This item was removed from the primes used in the present study. Although this cannot be ruled out, such a priming effect based on a single item would be remarkable.

The third possibility concerns a major difference between Chapter 5 and the present study; the length of the priming manipulation. In the former, the primes involved 20 items with 13 target items, while the present study used 10 item sets with five target items. While it is possible the present prime may have been too weak, this explanation is at odds with a corpus of research demonstrating effects achieved by primes like those used here (Rounding, et al., 2012; Shariff & Norenzayan, 2007). The differences in prime length have another implication. The longer primes in the former study required the sustained effort of participants for much longer than those used in the current study. Temporal discounting may have been increased as a result of the oft-described ‘ego-depletion’ effect (Baumeister, Muraven, & Tice, 2000). However, by this account Chapter 5 should have detected within subject increases for both conditions, unless the moral condition required more effort than the neutral condition.

Second, while temporal discounting rates have been increased experimentally by subjecting participants to a cognitive load task run concurrently with a discounting measure (Odum & Baumann, 2010), Cox (2005) had participants perform a difficult editing task prior to completing a temporal discounting procedure. Cox’s (2005) investigation, like Harrison and McKay (Chapter 5), conducted the tasks consecutively, and did not detect ‘ego-depletion’ effects.
With respect to the present study’s failure to detect an effect for religious primes in discounting rates, we offer two, compatible possibilities. While Rounding and colleagues (2012) found what looked like reduced temporal discounting for money in their second study, it is equally likely that the decision to wait a week for one extra dollar (not a compelling sum) represented reputation enhancement, the money being incidental. Money is a useful proxy for general temporal discounting rates; nevertheless, temporal discounting rates differ between domains (Odum & Baumann, 2010), which raises the possibility that participants’ discounting rates for social rewards may have been influenced, while discounting rates for money remained unaffected. This would not have been detected in our methodology because it was difficult to determine what a socially desirable response would look like, while it was easy to make that distinction in Rounding and colleagues’ studies. Rates of discounting for social rewards could be a difficult dependent variable to measure. An item of the form “Would you like a 20% improvement in how others think of you now or a 35% increase in 42 days?” is unlikely to make much sense to participants, hence the reliance on numerically quantifiable goods for measures of discounting, in spite of their limitations.

Aside from differences between this study and Rounding et al. in terms of social desirability bias, the complexity of the dependent variables may also have played a role. The single decision required in Rounding and colleagues’ second study may have elicited responses via relatively automatic, affective, and heuristic cognitive processes, dubbed ‘System 1’ by Daniel Kahneman, (2003; Kahneman & Tversky, 1979). System 1 decision processes are deployed rapidly, using ‘quick and dirty’ rules designed to free up the cognitively expensive, conscious resources required by careful deliberation (Kahneman & Tversky, 1979). Believing their participation in the study was over,
participants may have been unlikely to engage in the sophisticated and effortful calculations required to determine whether a week’s delay for one dollar was a worthwhile exchange. Thus, when presented with a decision over a trivial sum of money, participants for whom reputation had been rendered implicitly salient may have been more likely to advertise their personal credentials (i.e. patience) than calculate the relative worth of their options.

Conversely, in the present study participants were instructed to engage in the kind of effortful, conscious and deliberative processing associated with the decision processes Kahneman (2003) refers to as arising from ‘System 2’. Each session involved 15 decisions rather than one, probably encouraging participants to attempt to bid consistently (i.e. bids on $9.90 in two days should be higher than a bid for the same amount in 11 days). Participants also had more invested in the decisions, having been required to bring and bid with $30.00 of their own money. Moreover, understanding the procedure for a Vickrey auction requires the sustained attention of the participants. It is possible that such complex calculations interfered with potential priming effects, which by definition exert their influence via automatic processes (Bargh & Chartrand, 2005).

Conclusions

Despite indirect evidence that temporal discounting rates may be lowered by religious primes (Rounding et al., 2012) or scenarios describing moral wrongdoing (Böhm & Pfister, 2005), direct tests involving moral and religious priming have failed to demonstrate such a reduction on discounting rates for money. While interpretation of null results is inevitably problematic, Harrison and McKay’s (Chapter 5) result, taken together with the present result lends itself to a discussion on whether the observed effects in Rounding’s second study resulted from changes in the salience of social
capital (reputation) rather than changes to the value of delayed money. Increases in the perceived social value of the decision were pitted against the financial gains, and in the experimental group the social value of self-presentation may have won out more frequently. As Rounding and colleagues’ (2012) primary interest was social behavior, such an explanation makes their results very interesting. It seems far more likely that religion does not replenish depleted self-control or even alter the value of delayed monies, but motivates the decider to select a social goal over a financial one. Participants weren’t unable to select the later reward; they were simply unmotivated to do so unless reputational and social rewards were made salient by an appropriate cue.

From a technical viewpoint, this account has important implications for research into the determinants of temporal discounting and self-control. A primary difference between Rounding’s second study and the present study was the opacity of our temporal discounting measure. Although reputation, and potential observation, may have been made salient by the religion prime condition in the present research, it was difficult to act on when a socially desirable response was not clearly available.

The observed interactions between temporal discounting, religion and morality to date seem to suggest that social goals can trump financial ones in some circumstances, but not by reducing discounting rates for money. Rather, the observed effects may result from the activation of social goals, as the effects seem to occur in experimental designs where social goals are embedded in the dependent variable (examples being Böhm & Pfister, 2005; Rounding et al., 2012) and do not occur in studies where socially desirable responses are not obvious in the dependent measures (this study, as well as Hardisty & Weber, 2009). Further research into the motivating effects of social goals/rewards on impulsivity will prove a complex avenue for further study; but it is clear that dependent variables in such studies must be devised such that social and
financial goals are not confounded. Whatever the technical challenges, elucidating the conditions under which communicators should appeal to peoples’ financial or social goals when trying to reduce impulsive behaviours will make the project worthwhile.
References


Chapter 7

The Effect of Ego-Depletion on Subsequent Temporal Discounting Rates: Investigation of a Potential Confound.

This Chapter is presently under review at *The Psychological Record*. 
Abstract

The present study investigates a potential confound in supraliminal priming studies. Specifically, between-group differences in task difficulty may lead to differences in participants’ persistence on subsequent tasks. These differences may be mistaken for priming-induced changes in impulsivity and impatience. Implicit priming studies appear to show that exposure to religious or moral concepts influence participants toward behaviours that are broadly consistent with reduced impulsivity. Examples include volunteering and generosity (Pichon, Boccato, & Saroglou, 2007; Shariff & Norenzayan, 2007), as well as persistence and patience (Rounding, Lee, Jacobson, & Ji, 2012). Unexpectedly, Harrison and McKay (Chapter 5) found exposure to moral primes increased temporal discounting rates; with later failures to replicate this effect (Chapter 6) prompting suspicion the earlier result might indicate ego-depletion. Sixty-seven participants completed the moral and neutral primes used in Chapter 5. With time required to complete the primes a proxy for task difficulty; it was hypothesised that the ‘Fair’ priming stimulus would take longer to complete than the neutral task. The results supported this prediction. In Study Two, 237 participants completed the religious, moral and neutral primes used by Harrison and McKay (Chapter 6). No differences in task latency were detected. Our results indicate that between condition differences in task difficulty may be an important—and previously unappreciated—confound in the priming literature. Examples of priming effects where this is most likely to be an issue, such as aggression, are discussed.
The Effect of Ego-Depletion on Subsequent Temporal Discounting Rates: Investigation of a Potential Confound.

The priming literature contains an impressive corpus of studies where the implicit presentation of a concept or category influences participants’ subsequent behaviour (Dijksterhuis & Bargh, 2011). A much cited—if not always replicated—example describes participants walking more slowly than control participants after being supraliminally primed with ‘elderly’ stereotypes (Bargh, Chen, & Burrows, 1996; Doyen, Klein, Pichon, & Cleeremans, 2012).

The diversity of behaviours influenced by implicit priming manipulations—from aggression to altruism—is remarkable. While cognitive processes such as ideo-motor action and common coding (Dijksterhuis & Bargh, 2011) have been invoked to explain general priming effects, the cognitive representations that give rise to specific behaviours continue to be a matter of debate (Bargh, 2006). Why, for example, should the presentation of religious words cause participants to be more honest (Randolph-Seng & Nielsen, 2007), share more (Shariff & Norenzayan, 2007), wait longer, drink more unpleasant liquid (Rounding et al., 2012) or recognise secular moral words more quickly (Pichon et al., 2007)?

The cognitive processes that researchers claim are activated by various primes are as diverse as the behaviours they elicit. This leaves researchers with a great deal of latitude when it comes to explaining priming effects. For example, Shariff and Norenzayan’s (2007) religion primes have been credited with increasing ‘awareness’ of a supernatural watcher (Gervais & Norenzayan, 2012; Shariff & Norenzayan, 2007), replenishing self-control resources (Rounding et al., 2012) and activating secular moral ideas (Pichon et al., 2007; Randolph-Seng & Nielsen, 2007, 2008). These accounts assume the semantic content of the primes is the ingredient that—non-consciously—
influences subsequent behaviour. Such an assumption is not without its critics, and attempted replications of priming effects have met with variable results (Newell & Shanks, in press). Thus, it is important that any non-semantic explanations for priming effects be investigated and—if possible—ruled out. While Shariff and Norenzayan’s (2007) religious prime is one of the most replicated in the literature, not all have been replicated as reliably (see Newell & Shanks, in press, for a recent review of attempted and failed replication attempts), prompting investigations into alternative explanations for novel priming effects (Doyen et al., 2012).

The focus of the present study was an unusual secular moral priming effect detected in Chapter 5. Contrary to the hypothesis that moral primes would reduce temporal discounting rates, the study reported in Chapter 5 detected a significant within group increase in temporal discounting rates following exposure to 20 scrambled sentences, 13 of which contained secular moral concepts (e.g. ‘fair’, ‘equitable’) taken from the ‘Moral Foundations Dictionary’ (Graham, Haidt, & Nosek, 2009). This was unusual because moral primes often produce similar behavioural effects to religious primes (Pichon et al., 2007), behaviours commonly interpreted as indicating less, not greater impulsivity (Rounding et al., 2012; Shariff & Norenzayan, 2007). Harrison and McKay (Chapter 5) speculated that the prospect of a reward—enhanced social reputation—may have increased discounting rates, since environmental cues for potential sexual opportunity (Wilson & Daly, 2003) as well as cues for rewards through gambling (Dixon, Jacobs, & Sanders, 2006) have been observed to increase discounting rates. Harrison and McKay (Chapter 6) attempted to replicate and expand upon the results in Chapter 5 by using a smaller set of secular moral primes and adding the well-studied religious prime used by Shariff and Norenzayan (2007) and Rounding et al.,
(2012). However, no effects were detected for the religious or the secular moral primes (Chapter 6), prompting the present investigation.

A more prosaic explanation for Harrison and McKay’s (Chapter 5) unusual increase in temporal discounting rates may be ego-depletion. Ego-depletion refers to the reliable observation that participants who have previously exerted effortful control (such as resisting chocolate, editing manuscripts or concealing strong emotional responses) perform more poorly on subsequent tasks than those who have exerted less effort (Baumeister, Muraven, & Tice, 2000). The oft described ‘resource depletion’ account favoured by Baumeister, Muraven, and Tice (2000) and Rounding et al. (2012) suggests that having expended self-control, one is rendered less able to resist temptations, persist at difficult tasks or maintain concentration. While depletion of a metabolic substrate (i.e. glucose, see Gailliot et al., 2007) has been associated with subsequent increases in temporal discounting rates (Wang & Dvorak, 2010), resource based accounts for ego depletion have been cogently criticised on empirical and theoretical grounds in favour of computational and motivational models (Inzlicht & Schmeichel, 2012; Kurzban, 2010; Kurzban, Duckworth, Kable, & Myers, in press; Molden et al., 2012; Robinson, Schmeichel, & Inzlicht, 2010). Most importantly, motivational and cost/benefit models differ from resource based accounts in their emphasis on willingness, rather than ability. Instead of being literally unable to persist, resist or perform, ego-depleted participants experience fatigue as the product of a computational process, and thus are simply less motivated to continue, as the expectation that one is due for a rest (Inzlicht & Schmeichel, 2012), a change (Kurzban, et al., in press) or a reward (Molden et al., 2012; Robinson, Schmeichel, & Inzlicht, 2010) increases.
Moreover, the reduction on temporal discounting (TD) rates implied by Rounding and colleagues’ (Study Two; 2012) are much larger than any experimental manipulation of temporal discounting that we are aware of. Thus, Harrison and McKay (in press) suggested that a motivational—versus a ‘capacity’—account was a more parsimonious interpretation for all of Rounding and colleagues’ results, including Study Three, where Rounding et al. suggested that religious primes alleviated ego-depletion effects by replenishing self-control resources.

If ego-depleting tasks reduce the motivation to persist (or reduce the ability as per Rounding and colleagues (2012) account), then motivation to spend their money on a delayed sum may have decreased in response to effort expended during priming manipulation in Chapter 5. This prospect was considered prior to the study. Cox (2005) tested the effects of ego-depletion on TD rates with null results; this was the only test to our knowledge that measured TD rates subsequent to ‘ego-depleting’ cognitive tasks. Therefore, Harrison and McKay (Chapter 5) did not conduct a priori pilot tests for differences in difficulty between conditions. Moreover, the depletion explanation could only explain the results from Chapter 5 if the scrambled sentences in the moral condition were harder to solve than the neutral primes. A possibility the present study explored.

There are other reasons to suspect ego-depletion/reduced motivation might have confounded the study reported in Chapter 5, in spite of Cox’s (2005) null results. Tests of ego-depletion most often use persistence at cognitively taxing tasks (e.g. unsolvable puzzles) as their dependent variable, subsequent to an experimental condition designed to fatigue the respondent. However, following an editing task, which was more difficult for the experimental group, Cox’s (2005) temporal discounting measure (the dependent variable) used an ascending and descending titration procedure to measure participants’
discounting rate. This procedure presents participants with forced binary choices (e.g. 
‘$5 now or $100 in seven days?’), in the ascending measure the smaller sooner reward 
increases on each round until the respondent prefers it to the later reward. The 
respondent need only pick one of the options, which move in a predictable, sequential 
progression. Short of refusing to participate any further, there were no real 
consequences for either choice in this hypothetical task; there was no ‘easy way’ to do 
it, and the results of that effort were the same regardless of the decisions. Thus, we 
submit that the task may not have been sensitive to changes in motivation brought 
about by ‘ego-depleting’ tasks.

In Chapter 5, respondents were required to complete 20 scrambled sentences – 
which may have depleted their motivation in subsequent tasks in the same fashion that 
the editing task was designed to ‘deplete’ the participants in Cox (2005). These were 
followed by 30 one shot, Vickrey (1961) second price auctions. The auctions are an 
‘equivalent present value’ (EPV) task whereby the participant must nominate an 
amount they are willing to pay now for a delayed sum of money (e.g. $29 in 42 days). 
While EPV procedures are not as prone to framing biases, they are more difficult than 
Thus, we believe our dependent measure is more likely to be sensitive to changes in 
motivation.

In Chapters 5 and 6, decisions about delayed sums of money had genuine 
consequences. Participants were required to pay with their own money in the event they 
won the auction, take a receipt, keep it safe and return after a delay—of up to 42 days—
to collect their winnings. If participants’ motivation was reduced by the priming task in 
Chapter 5, the potential transaction costs involved in each decision would appear—
subjectively—more onerous compared to those who had not been similarly depleted.
Put another way, researchers correctly design their studies so that *objective* transaction costs are the same across conditions and delays (Kirby, Winston & Santiesteban, 2003; Harrison & McKay, 2012; Rounding et al., 2012). The studies described by Chapters 5 and 6 are no exception. However, if ego depletion *did* affect one condition more than others, the *subjective* transaction costs will reflect this; depleted participants will, by definition, find the same transaction more onerous due to their lowered motivational state. These increases in the subjective transaction costs will add weight to the delay in participants’ deliberations about how much to bid, resulting in participants offering less money now for a larger sum later. Smaller bids represent higher discounting rates.

As mentioned earlier, this account would only explain the results obtained in Chapter 5 provided—as we suspect—there were between condition differences in task difficulty. This is a possibility we proposed to test by timing how long it took participants to complete the scrambled sentence primes from Chapter 5; we used the time taken to complete the primes as a proxy measure of difficulty. If ego-depletion was responsible for the increases in temporal discounting rates observed in Chapter 5, then the average time taken to complete the priming tasks in the ‘Fairness’ secular moral condition should significantly exceed time taken in the ‘Neutral’ condition in that study.

### Study One

**Method**

**Participants**

Sixty-seven adults (54 females) with a mean age of 37 years ($SD = 11.2$) were recruited via their University email system and social networking sites.
**Materials and Procedure**

The study was conducted using participants’ own computers with the Inquisit program (Millisecond, 2011). Participants were sent an invitation to open a link to the online study, where they were presented with an information statement. Proceeding to the next page was regarded as indicating consent.

Participants were assigned at random to the ‘Fair’ or ‘Neutral’ unscrambling tasks as used in Chapter 5 (Appendix C). However, instead of a pen and paper task, the items were presented online, with the five word sets appearing at the top of the screen (black on white background). In each case participants were required to create a four word, grammatically correct sentence, typing it into a space provided at the bottom of the page. On pressing ENTER, the next item appeared. The participants were not instructed to complete the exercise as quickly as they could, but were instructed to work without pause until the task was completed. After the unscrambling tasks, participants completed a brief demographic survey. No incentives were offered for participation.

**Results and Discussion**

The Inquisit program recorded latencies for the completion of each item. The dependent variable for each participant was the average time taken to complete the items in their condition\(^{22}\). Following the recommendations of Wentura and Degner (2010), latencies that exceeded the item’s 75\(^{th}\) percentile (Tukey’s hinge) by more than 3 interquartile ranges were regarded as severe outliers and omitted from analyses. The data were skewed and kurtotic, necessitating logarithmic transformation, which rendered the data suitable for parametric analyses. There were no between group differences for participants’ age or education.

\(^{22}\)Participant’s average ‘per item’ latencies were used for ease of comparison with primes from Harrison and McKay (Chapter 6), which employed stimuli with only 10 sentences/items.
Participants unscrambling the twenty ‘Fairness’ sentences took significantly longer to complete the task \((n = 32, M = 19.65 \text{ seconds}, SD = 5.23)\) compared to those completing the twenty sentences in the ‘Neutral’ condition \((n = 35, M = 16.10, SD = 6.22, t(65) = 2.65, p = .015, \text{Cohen's } d = 0.62)\).

The effect size is large enough that the role of ego-depletion should be taken seriously as an alternative explanation for the results reported in Chapter 5. However, an obvious question arising from these results deserves investigation: What is it about the moral prime used in Chapter 5 that resulted in participants taking longer to complete them? There are two possibilities. First, there may be something about our secular moral (Fair) primes that required more concentration than their neutral counterparts. While it is possible that ‘Fair’ moral terms captured or directed participants’ attention in ways that the neutral stimuli did not, there were no significant differences in average latencies between the 13 target items in the ‘Fair’ prime, and the seven non-target neutral items. Nevertheless, it is still possible that the ‘Fair’ items activated reputational concerns—or concerns for fairness generally—causing participants to be more thorough and conscientious with all the items. In this case we would expect that the neutral items used in both conditions (Neutral & Fair) would have different average latencies; neutral items that were used in the ‘Fair’ condition would show larger latencies than the same items used in the Neutral condition. However, post-hoc analysis of the results detected no such differences.

Finally, it is possible that the difference between the priming conditions was idiosyncratic. Coincidentally, the three items in the ‘Fair’ set with the longest average latencies (items 2, 3 & 19; Appendix C) were ‘Fair’ items and, as such, did not appear in the Neutral set, nor did they appear in the shortened version of the Fair stimuli used in our attempted replication (Chapter 6). If these items were major contributors to the
observed increases in temporal discounting, via depletion of motivation, then their removal would result in similar average latencies between conditions. A post-hoc comparison of means with these items removed from the fair prime ($M = 18.75$ seconds, $SD = 6.11$), found just that; there was no longer a significant difference between conditions, $t(65) = 1.56$, $p = .125$.

As a further test of whether the semantic content of the primes were likely to play a role in any changes to the time taken to complete the tasks we tested all three conditions used in Chapter 6; Fair, Religion and Neutral. If the differences observed between the primes used in Chapter 5 are caused by the semantic effects of ‘moral’ items rather than idiosyncratic features, one might expect that the ‘Fair’ primes (and in light of Rounding and colleagues (2012) findings perhaps the religious primes as well) should return longer latencies than the Neutral primes, in spite of the fact that the three most difficult sentences had been removed.

**Study Two**

**Method**

**Participants**

Two hundred and thirty seven adults (178 females) with a mean age of 33.72 ($SD = 9.95$) years were recruited via their University email system and social networking sites. The response to this study was much greater, possibly because Study Two was conducted during the University teaching session, while Study One was conducted during a scheduled break.

**Materials and Procedure**

Except for the content of the three prime conditions, which were identical to those used in Chapter 6 (Appendix D), the procedure was the same as that used in Study One. Participants were randomly assigned to the ‘Fair’, ‘Neutral’ or ‘Religion’
conditions. In contrast with Study One, which presented 20 items per condition, the present stimuli contained only 10 items each.

**Results**

The Inquisit program recorded the time taken to complete each item. Individual scores large enough to indicate the participant had been interrupted or had unusual difficulty with the task were omitted, as per recommendations by Wentura and Degner (2010).

There were no significant age or education differences between groups, nor were there any significant differences in time taken to complete the tasks for the Fair ($n = 84$, $M = 16.26$ seconds, $SD = 6.19$), Religious ($n = 77$, $M = 15.50$ seconds, $SD = 6.06$) or Neutral conditions ($n = 76$, $M = 15.26$ seconds, $SD = 5.06$), $F(2, 234) = .582, p = .589$.

**General Discussion**

The present studies investigated an alternative explanation for the novel priming effect observed in Chapter 5; namely, that the secular moral primes increased temporal discounting rates via greater ego depletion—relative to the Neutral condition—rather than because of their semantic content. The 20 item ‘Fair prime’ used in Chapter 5 was the only priming manipulation to produce an increase in temporal discounting out of all the studies we conducted, and the only prime in the present study to take significantly longer to complete than its neutral counterpart. We submit that ego-depletion is a likely explanation for the priming effect observed in Chapter 5. It is likely this extra effort required by the ‘Fair’ condition (Study One) came about because of three quite difficult items in the 20 item fair prime, items that were serendipitously dropped from the subsequent replication attempt (Chapter 6).

The evidence for an idiosyncratic account would be more convincing (compared to a general effect for ‘moral’ concepts) if we had replaced the more difficult items and
run the Chapter 5 experiment again. So although it seems unlikely, the possibility that increases in temporal discounting were a combination of idiosyncratic effects and a general effect of moral primes cannot be completely ruled out. In either case, ego-depletion still features in the account; more depleted participants probably regarded the transaction costs and the delay as more onerous prospects and were thus less motivated to part with their money.

Baumeister, Muraven and Tice’s (2000) increasingly contested (Inzlicht & Schmeichel, 2012; Kurzban, 2010) resource account of ego-depletion seems an unlikely explanation for the results reported in Chapter 5. It is difficult to imagine how a participant’s self-control resources—glucose is one proposed substrate (Gailliot et al., 2007)—could be so depleted by a twenty item scrambled sentence task that they are less able to exercise self-control than those who completed twenty similar but marginally easier items. This is, as Kurzban (2010) correctly points out, tantamount to blaming a low battery for the fact that one’s computer is running slowly (p. 256).

We agree with Kurzban (2010) that the most parsimonious accounts lay in the computational domain (Harrison & McKay, in press). Inzlicht and Schmeichel (2012) proposed a mechanistic account of ego-depletion. Participants who have exerted much cognitive effort on a task experience shifts in motivation and attention to subsequent tasks. Specifically, the motivation to exert conscious control decreases while the motivation to act on impulse increases as one becomes more ‘depleted’. Moreover, attention to cues signalling that self-control is desirable reduces while attention to present rewards increase (p. 451). It takes little imagination to identify how this might impact temporal discounting rates, which are frequently cited as an indirect measure of impulsivity (Odum & Baumann, 2010; Reynolds, Ortengren, Richards, & de Wit, 2006; Richards, Zhang, Mitchell, & de Wit, 1999). We favour this mechanistic account of
‘ego-depletion’ (Inzlicht & Schmeichel, 2012) over the resource model. Below, we provide an account of how this motivational/perceptual model of ego-depletion likely affected bidding strategies, and therefore temporal discounting rates.

In the temporal discounting measure used in Chapter 5, participants were asked to bid precisely what the delayed money (e.g. $29.90 in 15 days) was worth to them now. In other words, we asked them to make bids on each trial that were equal to the undelayed amount ($29.90) less what they believed the delay (1-43 days), transaction costs and associated effort were worth, so that participants felt they had ‘broken even’. We propose that the subjective value of delays and transaction costs would increase as a function of participant’s ego-depleted state. A motivational and attentional—rather than resource based—account of ego-depletion (as proposed by Inzlicht & Schmeichel, 2012) would be congruent with this explanation. After expending considerable effort on twenty scrambled sentence puzzles, participants felt less motivated to commit to more effort (buy a receipt with their own money, and return after a delay – which they would have to remember to do). Thus, the recompense would have to be greater for participants who felt less motivated, resulting in smaller bids. Participants who had worked harder in the ‘Fair’ moral condition were likely to feel more motivationally ‘depleted’.

In addition to reductions in motivation to engage in effortful tasks, Inzlicht and Schmeichel (2012) argued that ego-depletion causes attentional shifts; ego-depleted participants are more likely to attend to cues of reward and less likely to attend to cues signalling that self-control is required. The delayed amount is also a reward—and a larger one—but self-control is required to get it. Conversely, the money one has with them may bring an immediate reward. The studies described in Chapters 5 and 6 required that participants bring their own money in order to bid on delayed sums of
money. Thus, each auction directed attention to the money the participant had brought with them, as well as how much they might receive after a delay (should they win the auction). We submit that if Inzlicht and Schmeichel are correct, then the more ego-depleted individuals became, the more likely they would be to attend to the money they had with them, and what they could use it for that day, increasing reluctance to part with it. Less depleted individuals, by contrast, would be more likely to attend to the self-control required to obtain a larger, delayed amount of money.

This explanation also has the advantage of accounting for why Cox (2005) did not detect effects for ego-depletion on temporal discounting rates. We have argued that participants’ estimates of the value of spending their own money versus the opportunity and transaction costs of winning the auction varied as a function of ego-depletion; Cox’s (2005) temporal discounting measure required no such estimates. Their measure was hypothetical, and did not require participants to agree to further effort, thus ego-depletion would not be expected to have much of an effect on Cox’s temporal discounting measure.

The general implications for the priming paradigm and its use in social psychology are worth noting. Assuming researchers who use supraliminal primes—especially puzzles—are not explicitly measuring and controlling for task difficulty, our results present a potential confound for studies where the dependent variable may be influenced by priming of social concepts and/or ego-depletion. Interestingly, Bargh and Chartrand (2005) invoke the resource model of ego-depletion when arguing for the primacy of automatic behaviours in everyday life, describing three systems that may be influenced by external cues in the absence of conscious awareness; these are the perceptual, evaluative and motivational cognitive systems. According to Inzlicht and
Schmeichel’s (2012) model of ego-depletion, sustained conscious effort affects the first and the third of these, via attention and motivation.

Research on external determinants of aggressive behaviour makes for an illustrative example. Bargh et al., (1996; Study One) used the scrambled sentence paradigm to prime aggression and politeness. Those primed with aggressive/rude words were subsequently much more likely to interrupt the researcher and a confederate, instead of waiting for further instructions. However, the effects of ego-depletion on aggressive behaviour are well documented and replicated. For instance, ego depleted individuals are more likely to retaliate against an antagonistor (DeWall, Baumeister, Stillman, & Gailliot, 2007; Stucke & Baumeister, 2006). Thus, if Bargh and colleagues’ (1996; Study One) ‘aggression’ prime was more difficult than the ‘polite’ prime, differential levels of ego-depletion could artefactually increase priming effects. Conversely, if the ‘polite’ primes were more difficult, ego-depletion could reduce or even reverse conceptual priming effects.

Rounding et al. (2012) purported to show that priming participants with Shariff and Norenzayan’s (2007) religious scrambled sentences appeared to ‘replenish’ the ability to consume more of an unpleasant tasting liquid (Study One), wait a week for a dollar to be added to the show up fee (Study Two) and persist longer at unsolvable puzzles after taking part in an ego depleting task (Study Three). The implications of differential ego-depletion between conditions are serious in this example. If the neutral condition was significantly more difficult to complete than the religious one, control participants would be more likely to quit at all of those tasks earlier, giving the impression of an experimental increase in self-control in the religious prime condition. While it may be that differential ego-depletion is only detectable for longer primes (i.e. twenty items versus ten) some priming studies ask participants to complete as many as
30 items (Doyen, et al. 2012). Interestingly, Doyen and colleague’s attempted replication of Bargh and colleague’s (1996) priming studies required translation of the primes, or their adaptation to the French language, it is possible such alterations might have changed the linguistic difficulty of the primes, affecting the results.

The present studies suggest task difficulty may be a confound that should be ruled out when investigating the effects of priming on behaviours such as self-control or aggression. Authors of existing studies that have not controlled for this potential confound would do well to conduct appropriate post-hoc tests to rule out this non-semantic explanation, especially in light of recent controversy over this popular experimental paradigm (Doyen, et al., 2012; Hardisty et al., 2011; Newell & Shanks, in press).
References


Chapter 8

Conclusions
Conclusions

In spite of assumptions that morality and impulsivity are to some extent antithetical, few efforts to specifically demonstrate this negative relationship have materialised in the relevant literature. This is possibly a result of the fact that the assumption is an old one. The restraint of one’s base impulses is a key plank in the ethics of virtue literature, one of the older branches of moral philosophy (Hursthouse, 1999). Ancient Greek philosophical traditions regarded the—apparent—inability or unwillingness to curb impulses as a moral failing; named ‘akrasia’ (Korsgaard, 1986; Kraut, 2010). Moreover, the phenomenology of other-regarding behaviours is generally congruent with the idea that ‘doing the right thing’ involves curbing competing impulses (e.g. leaving the last piece of pie for one’s son in spite of greedy impulses to the contrary). Perhaps this is why the assumed association has not received the scrutiny it deserves. But while phenomenology is naturally persuasive, it is not an accurate guide to the cognitive processes underlying decisions, instead it often functions as input into computations driving decision processes (Kurzban, Duckworth, Kable, & Myers, in press).

This thesis was conducted with a view to investigating two questions. The first of these was whether impulsivity is inversely associated with moral attitudes. With regard to the first part of the thesis, our intent was to investigate the relationship between general rates of impulsivity (measured as temporal discounting) and a more comprehensive moral taxon that included communal (‘Binding’), in addition to the usual ‘Individual’ moral concerns (Graham, Haidt, & Nosek, 2009; Graham, Nosek, Haidt, Iyer, Koleva & Ditto, 2011). A second assumption concerned situational influences of moral concepts on discounting rates. It had been implied in recent psychological literature that activation of moral—and/or religious—concepts can
suspend or eliminate temporal discounting (Böhm & Pfister, 2005; Hendrickx & Nicolaij, 2004; Rounding, Lee, Jacobson, & Ji, 2012). Below we address the results of Chapters 2, 3 and 4 and the first research question, after which the following chapters (5, 6 & 7) will be discussed, and the second question considered.

Chapter 2 detected indirect negative associations between discounting rates and the Individualising moral foundations, via the Internal scale of the Self-Importance of Moral Identity (paths ‘a’ and ‘b’ of our proposed model), but no direct correlations (path ‘c’). Moreover, once self-reported attitudes to time (ZTPI: Zimbardo & Boyd, 1999) were accounted for, temporal discounting rates ceased to be a significant predictor of scores on the Self-Importance of Moral Identity measure (Aquino & Reed, 2002). In Chapter 4, using a different method to measure discounting, positive associations between the moral foundations and temporal discounting rates were detected. Also contrary to our predictions was the finding that education mediated this relationship for the Binding, but not the Individualising moral foundations.

Temporal Discounting and Moral Concerns; Method Matters

When it comes to stable correlates between moral foundations and temporal discounting rates, it seems the method matters. Temporal discounting rates inferred by using the Monetary Choice Questionnaire (MCQ; Kirby, 2000; Kirby & Marakovic, 1996) in Chapter 2 were positively predicted by a fatalistic attitude to time, and inversely predicted by concern for the future (Zimbardo & Boyd, 1999), but had no direct relationship with moral foundations. This result lends itself to a suggestion that our hypothetical application of the MCQ\textsuperscript{23} lead participants to respond more in line with how they believed they should make decisions about delayed rewards, rather than in line with how they actually make such decisions.

\textsuperscript{23} Studies such as Curry, Price and Price (2008) also used the Monetary Choice Questionnaire, but offered to pay participants one of the choices, selected at random. Thus, their application was still largely, but not entirely hypothetical.
Chapter 3 provided test-retest reliability data for the ‘equivalent present value’ (EPV) temporal discounting measure, increasing the methodological options available to researchers studying temporal discounting. This is an important development in light of the evidence in the present thesis—and from Shamosh and Gray (2007)—that different methods for measuring temporal discounting might produce similar rates (Odum & Baumann, 2010), but that the rates obtained may have different correlations with other variables of interest. We do not believe such differences should be regarded as a recommendation for—or caution against—any particular method of measuring temporal discounting. Diverse methodological options should encourage investigators to match their studies to the ‘real’ life decisions they are interested in. Choice procedures like the MCQ, and ‘equivalent present value’ (EPV) procedures present different decision structures, which produce well-known effects on decision tendencies (Kahneman & Tversky, 1979; Loewenstein & Prelec, 1992). For example, a decision between a pleasurable reward now (e.g. going out for dinner) or a greater pleasurable reward later (e.g. an overseas trip) may be best represented by choice methods such as the Monetary Choice Questionnaire (Kirby & Marakovic, 1996). These choices both present to the decision-maker as a positive departure from one’s reference point (Loewenstein & Prelec, 1992). In either case the decision-maker experiences some positive hedonic impact.

On the other hand, consider decisions that involve an immediate negative departure from the decision-maker’s present reference point, with no immediate hedonic compensation, in exchange for a later reward. The decision to spend thousands of dollars now to install a photovoltaic power system in return for free power over the life of the system differs from the examples above in that one must take a present loss. Such decisions may be modelled best by ‘equivalent present value’ (EPV) procedures
like those used in Chapters 4, 5 and 6. Other-regarding behaviours frequently require a
cost on the part of the decision-maker, for example, does one sponsor a child in need or
rent a better computer? As discussed in Chapter 4, the EPV measure is arguably a more
ecologically valid approach when modelling decisions that have an ethical or moral
component.

Using the EPV procedure in Chapter 4, where participants were required to bid
on delayed sums using their own money\textsuperscript{24}, discounting rates were positively associated
with scores on the Moral Foundations Questionnaire. The associations were fully
mediated by education for the Binding foundations. Below we offer possible
explanations that may account for the differences between Chapters 2 and 4.

The most obvious explanation is that the difference in results are due to the fact
that Chapter 2 presented decisions about ‘hypothetical’ monies while Chapter 4
presented decisions that involved the expenditure of participants’ funds. However,
numerous studies have failed to find differences between discounting rates when
obtained via hypothetical versus genuine monetary decisions (Madden & Bickel, 2010).
Moreover, the differences between the methods in Chapters 2 and 4 include more than
just ‘hypothetical’ versus ‘real’ decisions. The magnitude of the rewards was also
different. While discounting rates were higher for Chapter 4, studies using decisions
concerning the actual exchange of money necessarily employ smaller amounts than
hypothetical studies. Chapter 4 was no exception. Therefore, while ‘real’ versus
‘hypothetical’ may have had some impact on discounting rates, it is equally like that the
higher temporal discounting rates observed for the ‘genuine’ monetary decisions could
be explained by magnitude effects (i.e. smaller amounts are discounted more than large
amounts) (Kirby, 1997). While magnitude of rewards can account for the differences in

\textsuperscript{24} A method originally adopted by Kirby and Santiesteban, 2003.
the size of temporal discounting rates, it does not account for the differences in the correlations with the moral foundations.

A third, compatible explanation concerns the structure of the choices presented discussed above. In Chapter 2, participants were presented with a choice between a small immediate gain, and a larger delayed one. Choice procedures such as the Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996) represent what Loewenstein and Prelec (1992) referred to as a positive departure from the present reference point. However, in Chapter 4, participants were required to reduce their financial situation by parting with their money in order to receive a larger amount later. Thus, in the latter study participants were presented with a negative departure from their present reference point. Loewenstein and Prelec’s (1992) seminal work on the effects of framing and reference points indicate that where consumption is delayed, loss aversion increases temporal discounting rates. This explanation has the advantage of providing some traction in accounting for the positive correlations between temporal discounting rates and the moral foundations; a result contrary to the first assumption that this thesis was conducted to investigate. If loss averse individuals are more likely to make smaller bids (which denote higher discounting rates), and these are associated with responses to the Moral Foundations Questionnaire, perhaps responses to moral questions are also, at least partly, a product of affective processes.

**Affective Forecasting; A Link Between Impulsivity and Temporal Discounting Rates**

Loss aversion refers to the finding that people will avoid choices that appear to the respondent as a loss, compared to materially equivalent situations presented as a gain (Kahneman & Tversky, 1979; 1991). Individual differences in loss aversion have been demonstrated to increase with age, income, accumulated wealth, but—
Interestingly—decrease with education (Gachter, Johnson & Hermann, 2010).

Importantly, loss aversion has also been conceptualised as an of error affective forecasting. Kermer, Driver-Linn, Wilson, and Gilbert (2006) argued that people are averse to losses according to the extent that they overestimate the hedonic impact of the loss in question.

The positive association between obtained temporal discounting rates and scores on the Individualising Moral foundations points to the possibility that, rather than being the product of reasoned selection, responses to the Moral Foundations Questionnaire (Graham et al., 2011) are driven by affective processes. This account is certainly in accord with the Social Intuitionist Theory of moral judgment (Haidt, 2001), which relegates moral reasoning to a post-hoc role, justifying affective reactions. Moreover, Haidt (2001) argued that respondents are very often unable to explain the origin of their moral decisions, a process Haidt dubbed ‘moral dumbfounding’. In sum, the extent to which one endorses an item in the Moral Foundations Questionnaire may be an automatic—and likely non-conscious—product of an anticipated hedonic impact of the rule’s transgression; whether that involves witnessing it (e.g. anger, disgust or contempt), being the victim of such a transgression (e.g. fear or anger), or thinking of oneself transgressing the rule (e.g. shame, guilt or fear of detection).

**Does education play a role in mediating affective forecasting?**

If the affective forecasting speculation is correct, what is it about education that mediates the effect? While it was anticipated that more education would predict increased endorsement of the Individualising foundations, it was observed that education was negatively associated with the Binding foundations, mediating their relationship with temporal discounting rates (Chapter 4). In terms of the relationship between temporal discounting and progressivism, this result is very similar to what was
predicted, albeit via a different route. Education predicted lower Binding foundation scores, instead of higher Individualising foundation scores, but in either event the result is greater Progressivism. This result is congruent with Luguri, Napier, and Dovidio’s (2012) observation that having participants adopt an abstract mindset (i.e. solving problems using general principles transferred from one domain to another), reduced intolerant attitudes toward members of out-groups among politically conservative respondents. The authors argue that the function of higher education—among other things—is to develop in its participants the ability to take an abstract mindset to novel situations. In other words, education probably reduces aspects of political conservatism that encourage intolerance.

It is interesting that the affective forecasting effects mentioned above only seemed to affect Individualising moral foundations. We suggested that rapid, non-conscious, and emotional decision processes (called 'System 1' processes by Kahneman & Tversky, 1979) drove responses to Individualising items in the Moral Foundations Questionnaire (MFQ: Graham et al., 2011) because they did not conflict with the Individualised moral cultures promoted by the educational institutions, of which participants were members. There was no reputational risk in endorsing them. With no need to deliberate on whether the moral rule in question (Fairness, Care) was appropriate or endorsed by one’s peers, a quick emotional response was all that was required. As discussed above, loss averse individuals—by definition—tend toward more extreme affective forecasts, so they would be likely to more highly endorse Fairness and Care items in the MFQ. Of course, in the absence of explicit measures of affective forecasting/loss aversion this account remains in the speculative domain.

Binding moral foundations (Loyalty, Authority and Purity) on the other hand are less frequently endorsed in higher educational institutions (Graham et al., 2009), and
may even be regarded as undesirable in social science faculties, at least in the United States (Haidt, Graham & Nosek, 2009; Henrich, Heine, & Norenzayan, 2010; Inbar & Lammers, 2012). Regardless of whether they agree with one’s personal values, when participants were presented with items concerning ideologies that are incongruent with the stated values of their institution (all participants were from the same university/college, where the studies took place), some effortful deliberation was likely entered into. Reputational concerns likely prompted an assessment of whether it was socially politic to endorse unpopular moral ideologies (e.g. ‘men and women have different roles to play in society’). It does not seem far-fetched to suggest that people are sensitive to the prevailing socio-moral environment, and that this might affect the moral values they publicly subscribe to. Most people can recall social situations where they felt it might not be wise to broadcast their moral convictions too openly for fear of recrimination, being ostracised or reducing their social capital. Social desirability may have reduced the influence of affective responses in favour of more consciously deliberated ones.

**Differences in affective force between binding and individual foundations.**

However, there are other differences between the Individual and the Binding foundation items that might have influenced the results in Chapter 4. As discussed in Chapters 2 and 4, the moral foundations of Fairness and Care have the Individual’s rights and protections as the locus of moral concern (Graham et al., 2009; Haidt & Graham, 2006; Haidt & Joseph, 2006). It is possible that imagining an offense against a person or animal (e.g. ‘hurt a defenceless animal’ or ‘kill a human being’) has greater affective force than imagining a violation of a communal rule (e.g. ‘violated standards of purity or decency’). In the latter case one must imagine what such violations might look like for themselves, while less imagination is required in the former case. That
items describing moral transgressions were more highly correlated with temporal discounting rates than positive or neutral items were, and that discounting rates were most highly correlated with items describing harm to people and animals (Chapter 4), is certainly congruent with this account. It is also congruent with other recent research. Decety and Cacioppo (2011) studied the neurophysiological reactions of participants while they responded to two short films, both involving injury to a person, one intentional and one accidental. Their results indicated that emotional reactions to the ‘intentional harm’ condition were greater than for the accidental harm condition, and that emotional responses did indeed precede moral judgments, supporting arguments for the primacy of affect in moral judgment, at least where issues of Harm/Care are concerned (Haidt, 2001; Haidt & Bjorklund, 2008).

Replication of the study described in Chapter 4 with populations that tend to emphasise the Binding moral foundations—such as a military college or religious seminary—might clarify the issue. If the ‘congruence with institutional values’ account is correct, length of time spent in an institution which emphasises communal/binding values may mediate the relationship between discounting and scores on the Individualising—rather than the Binding—foundations. The Binding foundations would have a direct association with temporal discounting rates. If the latter ‘Imaginability’ account is correct, and moral rules concerning individual rights elicit affective reactions by virtue of the fact that individual suffering is easier to imagine than collective harm, replicating the study within a military or religious institution should make no difference.

It is clear is that strength of moral attitudes, of any kind, are not dependent on lower discounting rates. It may be the case that moral behaviour and attitudes diverge on this point; that moral behaviour is really associated with lower discounting rates
(Curry, Price & Price, 2008) while moral attitudes are associated with higher rates (Chapter 4). This would be a curious finding. But it is also possible that aversion to the prospect of transgressing a moral rule could be a driver of moral behaviour. If affective forecasts of the hedonic impact of moral transgressions (involving harm or inequity) extend to reputational concerns, and/or empathetic concerns for others, this seems plausible. It is clear that opportunity cost and participants’ point of reference (spending money [Chapter 4] as opposed to choosing between two gains [Chapter 2]) are important factors when studying the role of impulsivity in moral attitudes.

The other important goal of these studies was to differentiate between different kinds of moralities, and their associations with impulsivity. While Graham et al., (2011) provide ample evidence that the items in their Moral Foundations Questionnaire describe five distinct moral foundations, the present thesis agrees with a growing corpus of work, such as van Leeuwen and Park (2009) and Hirsh, DeYoung, Xu, and Peterson (2010) that personality and attitudinal correlates of moral attitudes tend to diverge along Individualised and Binding parameters more than the finer grained distinctions between Fairness and Care, or Authority, Loyalty and Purity.

Section Two: Can Moral Concepts Suppress or Suspend Temporal Discounting?

Chapters 5, 6 and 7 were concerned with the second of the two assumptions examined in the present thesis. That is, can raising the salience of moral (or religious) concepts lower or eliminate impulsivity? Recently, arguments that religious concepts can suppress selfish impulses (via the activation of moral codes and reputational concerns, Randolph-Seng & Nielsen, 2007; 2008) and replenish self-control (Baumeister, Bauer, & Lloyd, 2010; Rounding et al., 2012) have become increasingly common. Moreover, Graham, Haidt and Rimm-Kaufmann (2008) suggested that morality also serves to ‘suppress selfishness and make social life possible’ (p. 21).
Priming with religious concepts make secular moral words more accessible in lexical decision tasks (Pichon, Boccató, & Saroglou, 2007), while priming with secular moral concepts produces increases in other-regarding behaviours (Shariff & Norenzayan, 2007). Taken together with Böhm and Pfister’s (2005) argument that environmental conservation issues are immune to the influences of temporal discounting because of their ‘strong moral component’ (p. 461), we predicted that priming participants with secular moral concepts should reduce impulsivity on subsequent measures of temporal discounting.

Contrary to predictions, temporal discounting rates appeared to increase as a result of priming with secular moral concepts in Chapter 5. Within subject comparisons indicated that following supraliminal priming using ‘Fairness’ concepts from the Moral Foundations Dictionary (Graham et al., 2009), discounting rates increased following exposure to the priming manipulation, compared to another session where the same participants were not primed. Control group participants showed no such increase. However, the increases were not unequivocal; while within group increases in discounting were significant, the differences in discounting rates from time one to time two were not significantly different between conditions (i.e. \( T_1 \text{fair} - T_2 \text{fair} \) not \( > T_1 \text{control} - T_2 \text{control} \)).

Nevertheless, we attempted to explain the effect by speculating that such an increase may be compatible with signals of potential social rewards; for example, the opportunity to signal one’s good characteristics. Since the prospect of reward may increase temporal discounting rates (Dixon, Jacobs & Sanders, 2006; Wilson & Daly, 2003), we reconciled our result with previous literature by suggesting that what appeared to be reductions in temporal discounting (increased persistence or other regarding behaviours) as a result of moral (or religious) priming may actually represent
the pursuit of an immediate social reward (Böhm & Pfister, 2005; Rounding et al., 2012). Benevolence has been demonstrated to produce greater happiness than self-centred behaviour (Dunn, Aknin, & Norton, 2008), and stimulate neuronal activity in the same way that monetary rewards do (Izuma, Saito, & Sadato, 2008). We acknowledge that happiness is not the same thing as reputational rewards, but we proposed that other-regarding behaviours may make people happier (a proximal reward) because an improved reputation may secure adaptive benefits like having peers assist one in difficult times (the ultimate benefit). Cues of such potential rewards might increase temporal discounting rates.

The main conclusion arising from Chapter 5 was that if moral primes produce behaviour that looks like a reduction in impulsivity, but are really an increase brought on by the prospect of a social or reputational reward, such a novel outcome calls for a convincing replication. Moreover, replication of such an effect would have better support if a priming stimulus that is well known to increase other-regarding behaviour—such as Shariff and Norenzayan’s (2007) religion primes—were used.

Chapter 6 concerned itself with replication of the effects from Chapter 5, as well as adding Shariff and Norenzayan’s (2007) religion prime. The ‘Fairness’ prime used in Chapter 5 was shortened to 10 sentences (five targets and five neutral items) to match the religion prime; an alteration of design that would turn out to be crucial. The results of Chapter 6 were null, and did not trend in the hypothesised direction. No effects for the fair or the religion primes were detected.

For Chapter 6, there were three possible outcomes. Moral primes would either decrease discounting rates, as implied in the literature, increase discounting, as occurred in Chapter 5 (although this may not have been a result of moral semantic content, a topic we return to below), or have no effect. In Chapter 6 the third outcome
was evident, and it is therefore reasonable to conclude that moral concepts do not decrease discounting—at least not for money—and probably do not increase discounting rates either. Notwithstanding, the effects brought on by moral (Böhm & Pfister, 2005; Shariff & Norenzayan, 2007) and religious cues (McKay, Efferson, Whitehouse, & Fehr, 2011; Randolph-Seng & Nielsen, 2007; Rounding et al., 2012; Shariff & Norenzayan, 2007, 2011), look like reduced impulsivity and increased persistence. So what are we to make of the present results?

**It might be discounting, but not for money.**

The first possible explanation involves domain specificity. While it is probably accurate to conclude that religious and moral primes do not affect discounting rates *for money*, discounting rates have been shown to differ according to commodity. For example, Hardisty and Weber (2010) found that discounting rates differed for health outcomes and money, as did Chapman (1996). Gattig and Hendrickx (2007) noted that environmental value tends to be discounted at a lesser rate than money. In moral and religious priming studies, participants show increased persistence or ‘other regarding’ behaviours subsequent to priming; the question is, *if* discounting is being reduced by the primes, discounting of *what?* If discounting for money is unaffected by priming with religious and moral concepts, how do the primes exert their effects on subsequent behaviour? We submit that religious and secular moral primes increase the salience of reputation, thereby influencing the behaviour of participants. There are two ways this might occur. Priming with moral concepts might reduce discounting rates for social reputation rewards, causing them to be selected over financial rewards, or discounting may play no role at all. The implicit behavioural priming literature is increasingly demonstrating that social goals can be made salient, influencing subsequent behaviour in the direction of those goals (Bargh, 2006; Bargh & Chartrand, 2005; Dijksterhuis &
Bargh, 2011). But it may be that in the ‘non-primed’ conditions, reputational concerns are ‘never in the race’ with monetary concerns because they have not been activated by the relevant primes.

Nevertheless, good news about one’s reputation is rewarding and may be thought of as a form of currency. Functional magnetic resonance imaging (fMRI) studies indicate that good news about one’s reputation are processed by similar neural paths as monetary rewards (Izuma et al., 2008); monetary and social rewards are represented by a single ‘neural currency’ that allows the decision maker to compare the relative value of rewards from different domains. What is more, the prospect of observation demonstrably raises the salience of social, over monetary, rewards (Izuma, Saito, & Sadato, 2009). Signals of potential surveillance also increase socially desirable responding (Gervais & Norenzayan, 2012) and the severity of condemnation of moral transgressions (Bourrat, Baumard, & McKay, 2011). We suspect that priming with religious and moral concepts activate in the participant a sensitivity to the prospect of surveillance, which raises the subjective value of reputational rewards; rewards that are pursued by responding in a socially desirable manner.

This may explain the null results in Chapter 6. It appears that if moral or religious primes altered the subjective value of anything, they increased the value of social rewards, relative to financial ones (delayed or otherwise). This account is congruent with the interpretation that participants—primed with religious or moral concepts—more frequently selected socially desirable responses over financially advantageous ones when reputation was made salient (Gervais & Norenzayan, 2012; Randolph-Seng & Neilsen, 2007; 2008). Signalling one’s good qualities to real or imagined observers; qualities like persistence (Rounding et al., 2012; Studies 1 & 3), patience (ibid. Study 2), generosity (Shariff & Norenzayan, 2007), honesty (Randolph-
Seng & Nielsen, 2007) or willingness to volunteer (Pichon et al., 2007), was more rewarding than the alternative for participants who were primed with religious and moral concepts because the primes raised the salience of an immediate social reward, not because it lowered the value of a financial one. The study described in Chapter 6 differed from the studies described above in that our dependent variable was relatively opaque in terms of social desirability. For our participants, it was not at all clear what a more socially desirable response would be. Does it look better to bid more—or less—for a delayed sum when asked ‘how much you would pay today for $29.90 in 35 days’? Moreover, participants made 15 such decisions in each session. While higher bids denote greater patience, this is not as obvious as a choice between $5 today and $6 in a week (Rounding et al., 2012; Study Two).

In addition, the idea that the salience of reward (rather than religion or morality per se) drives behaviour changes following priming with religious concepts has received some recent empirical support. Harrell (2012) presented participants with a lexical decision task which included religious (and reputational) primes that implied reward (e.g. ‘heaven’), compared to religious primes that did not imply rewards (e.g. ‘temple’). Harrell also compared reward related non-religious words (e.g. ‘applause’) to non-religious neutral words (e.g. ‘ocean’). Participants were then offered the opportunity to leave part of an $8 stake for another participant, with whom they would have no contact. While there was no main effect for the religion conditions, there was a main effect for the reward conditions. In sum, if the prime words implied reward (religious or secular), participants left more money for the ‘receiver’ than if the prime did not imply a reward, regardless of the religiosity of the words. For present purposes, the nature of the rewards that Harrell used is particularly telling. While Harrell (2012) might have used words implying monetary or material rewards in the non-religious
condition (e.g. ‘money’ or ‘profited’), the words used implied social rewards (e.g. ‘applause’, ‘popular’). It appears that raising the salience of social rewards was compelling enough to induce participants to give more money to an anonymous receiver.

All the above notwithstanding, it remains to be demonstrated whether implicit moral or religious priming actually alters discounting rates for social rewards. While it would be obscure to ask participants to choose between a 20% improvement in their social reputation now versus a 35% improvement in forty days, it may be possible to measure discounting for reputation in other ways.

There are two possible forms of reputational currency. On the one hand there is how good one’s reputation is (content of reputation), on the other hand there is the issue of how many people one has a good reputation with (spread of reputation). In the former case, participants might take part in two third-party punishment/reward games, each with three players. Player A has an endowment of $10 and decides how much to transfer to B. Player C then has the opportunity to spend money to punish or reward A. In both games our participants assume the role of A (i.e. they decide how much to transfer to B, knowing that C can then punish or reward them). In the first game they are told that C will immediately be informed of their decision and will then make a punishment/reward decision. Subsequent games would involve a temporal manipulation of delays until player C is informed of player A’s decision, at which time C would either punish/reward the decision. For example, before the participant A makes their decision about how much to pay player B, they would be informed that C will not learn of their decision for three (or five, or ten) days. In both cases A has to decide how much to transfer to B, knowing there are reputational consequences. In the first case the reputational effects are immediate, but in the second case there is a delay. If one
assumes that the amount participant ‘A’ transfers to ‘B’ is the value of the reputational gain they are ‘purchasing’ with player ‘C’, then one could calculate temporal discounting rates for reputation.

A potential approach to measuring the reach of social reputation may be to manipulate the number of people that witness or are made aware of the participant’s favourable qualities. For example, following a priming task, participants may be asked to give a brief speech, present a gift to a research assistant, or perform some other behaviour that casts them in a favourable light. If consent is obtained, participants would be asked to decide when they would like to perform this act; tomorrow, when three people will be present, or in a week when ten people will attend. If participants—primed with moral concepts before being asked to perform the act—are more likely to elect to wait a week to perform the act before a larger group (compared to a control group), we might suppose that priming has resulted in a lower discounting rate for social rewards.

**Task Difficulty: An Unappreciated Confound**

As the results described in Chapter 7 point out, the increase in temporal discounting rates detected in Chapter 5 are most likely accounted for by differences in task difficulty between conditions. The moral priming manipulation in Chapter 5 took significantly longer (by average time to complete each item) to complete than the neutral prime, or any of the primes used in Chapter 6. Post-hoc testing ruled out general semantic effects, and indicated that idiosyncratic effects were more likely to have produced the obtained results.

One of the main aims of the supraliminal priming research paradigm is to tease apart the various and subtle influences of environmental cues on social behaviour. Contrary to Cox’s (2005) finding that between condition differences in cognitive load
(on a difficult editing task) had no effect on subsequent measurements of temporal discounting rates, it is apparent from Chapter 7 that differences in task difficulty between conditions should be added to the inventory of potential confounds to avoid.

The results of the studies in Chapter 7 determined that a few difficult items were the likely cause of the increased temporal discounting rates observed in the moral prime group (Chapter 5). This finding sounds a note of caution to researchers whose dependent variables of interest may be affected by motivational changes brought about by recent cognitive effort. Priming research on aggression and impatience are the most obvious examples (Bargh & Chartrand, 2005; Stucke & Baumeister, 2006).

Clearly, the relationships between trait impulsivity and moral attitudes are complex. Chapters 2 and 4 indicate that the relationship between impulsivity (as measured by temporal discounting rates) and moral affect are not uniform across the entire taxon of moral attitudes, but may depend on whether the cultural milieu one is exposed to via education emphasises Individualising or Binding moral concerns, although this remains to be demonstrated by further research. What is more, such relationships only appear to come to light when the decisions used to measure impulsivity involve an immediate cost to the decision-maker.

Cultural influences would not be surprising, congruent as they are with Henrich, Heine and Norenzayan’s (2010) observation that many of the cognitive processes researchers have regarded as likely to be universal (e.g. the Muller-Lyer effect) are in fact dependent on the culture and life experiences of the participant cohort used to describe them. Moreover, Henrich, et al., (2010) argue that trying to strip away the cultural milieu in order to examine ‘universal cognitive processes’ is to misunderstand human cognition, which is as much a product of culture as biology. Relationships between temporal discounting rates and moral attitudes do not appear to be an
exception to this, and are probably exemplars of it. Nevertheless, it seems safe to conclude assumptions that stronger moral attitudes are antithetical to impulsivity, or that moral cues may suppress impulsivity—at least in the domain general sense—are unfounded.

Ruling out the questions discussed above does not conclude research into the associations between morality and impulsivity. Instead, this thesis has elucidated some promising targets for further research. For example, are the relationships between impulsivity and moral concern subject to the content of cultural transmission in education? If education does have such an impact, what are the developmental trajectories of those influences? Concerning moral (and religious) implicit cues, it is very likely that the subjective value of reputation is being affected by the implicit primes in question. However, the—fascinating—question arising from these results concerns the nature of priming effects. For those who are not primed with religion, are reputational concerns part of the computation at all when making decisions about the relevant dependent variables? It seems unlikely that such concerns are entirely dormant in those not specifically primed by moral or religious cues. If they do play a role in ‘unprimed’ participants, but that role is greater for those primed with the relevant cues, what is it that has been altered? Has temporal discounting for reputational gains been reduced or suspended, compared to those who are not subject to moral cues?

Answers to such questions have obvious implications for education, as well as the development of appropriate behavioural ‘nudges’ (Thaler & Sunstein, 2008) in important social contexts. It is hoped that the empirical findings contained in this thesis, in addition to the methodological contributions (Chapter 3 & 7), will be built upon by some of the research suggested above. Finally, any differences identified between Individualised and Binding moral attitudes should not be interpreted as
endorsement of either as normatively superior. On the contrary, any line of research that broadens empirical and theoretical understanding of the function, origins and effects of different moral loci (i.e. individual versus collective) is likely to bring important benefits. Such understanding may be particularly beneficial in contemporary societies where the ‘culture wars’ tend to conceptualise increasing heterogeneity as a problem to be solved, rather than an opportunity for increased social vitality.
References


Appendix A
Vickrey Second Price Auction Task Instructions

This session consists of a series of auctions (for real money!). In each round you will be offered the opportunity to purchase an amount of money that would be delivered to you in a specified number of days. So, for example, you might be offered the opportunity to pay today in order to get back $19.90 in 30 days. (This “$19.90 in 30 days,” will be referred to as the “delayed money.”) You decide how much you are willing to pay today to get the delayed money.

Our goal is to try to find out exactly how much the delayed money is worth to you today. (The amount that you report will be called your ‘bid.’) We would like for you to give a bid such that paying out that amount today and getting the delayed money back in the number of days specified would exactly balance out—you would neither profit nor lose in the exchange. To put it another way, your bid should be the price at which you could buy the delayed money and exactly break even.

Why would you want to bid in such a way that you would just break even?

Because we have arranged it so that bidding exactly what the delayed money is worth to you gives you the best chance of actually making a profit. This is a little complicated, so please read the instructions carefully and ask the experimenter questions until you fully understand it. Here’s how it works:

Your bid will be entered into an auction against the other participants where the highest bid wins. If your bid is higher than anyone else’s bid, you may purchase the delayed money for the lower price given by participant who gave the second highest bid. This is a good deal for you, because it means that you will actually pay less for the delayed money than what it is worth to you today, which means that you make a profit.

The reason for using this procedure is to make sure that the best thing for you to do is to bid exactly the amount that the delayed money is worth to you today. If you win, you are guaranteed to purchase the delayed money at a lower price than what you bid. So if you bid accurately, you can only profit—you cannot lose money. What you bid determines whether you win or lose, but not what you pay: what you pay is determined only by the second highest bid.
Example 1: Bidding too high.

You can lose money if your bid is higher than what you are really prepared to pay for the money. Because of the possibility of buying the delayed money at a profit, you may be thinking that you should bid higher than what the delayed money is really worth to you in order to give yourself better odds of winning. However, suppose that the second highest bid also is ALSO higher than what the delayed money is worth to you; you wouldn’t want to win because you don’t want to buy the delayed money at that higher price. If the second highest bid is lower than what the delayed money is worth to you, then bidding high doesn’t make any difference. Therefore, since you won’t know whether the second highest bid is more or less than your bid, you should never bid more than what the delayed money is worth to you, because it can only cause you to pay too much today, without helping you.

Example 2: Bidding too low.

So now you may be thinking that you would be better off bidding low to try to make sure that you don’t pay too much. However, if you bid low you decrease your chances of winning (and making a profit), which is just as bad as paying too much. Suppose that the others bid less than what the delayed money is worth to you: you do want to win because you would make a profit by buying the delayed money at that lower price. But if you bid low you risk losing out on this profit. If the others bid is higher than what the delayed money is worth to you, then bidding low doesn’t make any difference.

Therefore, since you won’t know whether the other participants will bid more or less than your bid, you should never bid less than what the delayed money is worth to you, because it can only cause you to miss out on a profit.

To summarize:

By bidding exactly what the delayed money is worth to you today, (a) you make your odds of winning as high as they can be without risking having to pay too much today, and (b) you are guaranteed to make a profit if you win.

How Your Reward Is Chosen

This auction is for real money! One round will be chosen at random at the end of the experiment, and the bids on that round will determine whether you win and how much you will asked to pay (second highest bid). Because you don’t know in advance which round will be chosen to be the real round, it is important that you treat every round as though it were the real one.
If you win the bid on the real round you will be asked to pay the experimenter the lower amount of the second highest bid before you leave today. You will get a receipt for the money and you will be able to pick it up at the School of Psychology Office when the delay period has expired. If you will be out of town at the time that the delayed reward comes due we will send the cash to you on the due date by overnight mail — rest assured that delivering the money as promised form part of our ethical obligations and we take those very seriously.

PLEASE NOTE:

• This is a real auction for real delayed monetary sums; the money is guaranteed by Charles Sturt University.
• The one ‘paying’ round is really chosen randomly after the session.
• The best strategy for you is to bid exactly what the delayed money is worth to you today, no more and no less.
• There are no hidden motives or tricks.
• The first three auctions will be a practise run before the genuine auctions begin.

Adapted from:

Appendix B

Descriptive data comparison – Chapters 2 and 4.

Means, Standard Deviations† and Cronbach’s Alpha estimates for Temporal Discounting measures, Moral Foundations Questionnaire, Zimbardo Time Perspective Inventory, Self Importance of Moral Identity Scale.

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†For temporal discounting measures, SEM is reported in parentheses, instead of SD. Untransformed means are reported. AUC (Area under the curve) is a measure of ‘patience’ and therefore will show correlations of the opposite sign to the k parameter correlations.

*p < .05 ** p < .01 (independent samples t test, two tailed)
Appendix C

Priming Stimuli: Chapter 5 (Fair condition)

Instructions - for each set of words below, please make a grammatical four (4) word sentence and write it down in the space provided. For example:

flew eagle the plane around the eagle flew around

1. trees horses were the enormous
2. was eventual considered essential impartiality
3. increased accumulated declined equity my
4. egalitarian system was insert the
5. constant was tremor sound the
6. orange coat the brown was
7. was entered fair exciting the
8. unbiased were attend selections made
9. the push wash frequently clothes
10. interested they very he was
11. straight the veered road right
12. equality had interest demanded they
13. chickens count ducks don’t your
14. terms reasonable they could were
15. north birds drive migrating fly
16. wavered in orange confidence justice
17. frost acacias tolerant drought are
18. prepare the gift wrap neatly
19. health gifts diets balanced improve
20. end their reciprocated was action
Appendix C

Priming Stimuli; Chapter 5 (Neutral condition)

Instructions – for each set of words below, please make a grammatical four (4) words sentence and write in down in the space provided. For example:

flew eagle the plane around the eagle flew around

1. orange coat the brown was ________________________________
2. north birds drive migrating fly ________________________________
3. interested they very he was ________________________________
4. almonds bitter the mango tasted ________________________________
5. tree horses were the enormous ________________________________
6. prepare the gift wrap neatly ________________________________
7. the push wash frequently clothes ________________________________
8. saw hammer the train he ________________________________
9. sky the seamless blue is ________________________________
10. inside cooler was outside it ________________________________
11. ball the throw toss silently ________________________________
12. there hide over under it ________________________________
13. door ajar it the was ________________________________
14. taller heavy seem only they ________________________________
15. softly the snow silent fell ________________________________
16. were longer getting after days ________________________________
17. car here road leave the ________________________________
18. they she agree not could ________________________________
19. returned they long arrived before ________________________________
20. every it morning rained night ________________________________
Appendix D

Priming Stimuli; Chapter 6 (Fair Condition)

Instructions - for each set of words below, please make a grammatical four (4) word sentence and write it down in the space provided. For example:

flew eagle the plane around  the eagle flew around

1. constant was wooden sound the
2. orange coat the brown was
3. was entered fair exciting the
4. unbiased were attend selections made
5. the push wash frequently clothes
6. equality had extend demanded they
7. north birds drive migrating fly
8. frost acacias tolerant drought are
9. prepare the parcel wrap neatly
10. end the reciprocated was action
Appendix D

Priming Stimuli; Chapter 6 (Neutral Condition)

Instructions - for each set of words below, please make a grammatical four (4) word sentence and write it down in the space provided. For example:

flew eagle the plane around the eagle flew around

1. orange coat the brown was                            
2. north birds drive migrating fly                       
3. interested they very he was                           
4. trees horses were the enormous                        
5. prepare parcel the wrap neatly                       
6. the push wash frequently clothes                     
7. saw hammer he train the                              
8. sky the seamless blue is                             
9. inside cooler was outside it                          
10. ball the throw toss silently                         


Appendix D

Priming Stimuli; Chapter 6 (Religion Condition; Shariff & Norenzayan, 2007)

Instructions - for each set of words below, please make a grammatical four (4) word sentence and write it down in the space provided. For example:

flew eagle the plane around  the eagle flew around

1. felt she eradicate spirit the ____________________________
2. dessert divine was fork the ____________________________
3. appreciated presence was imagine her __________________
4. more paper it once do _________________________________
5. send I over it mailed _________________________________
6. evil thanks give god to ________________________________
7. yesterday it finished track he __________________________
8. sacred was book refer the ______________________________
9. reveal the future simple prophets _______________________
10. prepared somewhat I was retired ________________________