Journal of Articles in Support of the Null Hypothesis
Vol. 10, No. 1

www.jasnh.com

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

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Rounding, Lee, Jacobsen and Ji (2012) reported that priming with religious concepts increases the ability to delay gratification, an interpretation that implies decreased temporal discounting. The required magnitude of such a decrease—to make participants respond in the way Rounding et al. report—is very large, and should be easily detectable. Sixty-nine participants were allocated to religious, secular moral (Fairness) or neutral priming conditions. Temporal discounting rates were estimated for each participant using an 'Equivalent Present Value' procedure prior to and following the sentence unscrambling primes. No effects for priming conditions were detected. With regard to theoretical explanations for the results, we suggest that it is not the ability—but motivation—to delay gratification that is influenced by religious concepts.

Acknowledgements:
This work was supported by an ESRC Large Grant (REF RES-060-25-0085) entitled "Ritual, Community, and Conflict."

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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 have 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 their 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 1), delayed gratification (Study 2), persisted with unsolvable puzzles (Study 3) and suppressed redundant responses on a Stroop test (Study 4) 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 the present study. The present study altered Rounding et al.'s second experiment to include an explicit measure of temporal discounting that was opaque in terms of socially desirability, and attempted to replicate Harrison and McKay's (in preparation) finding 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).

Harrison and McKay (in preparation) primed participants with secular moral concepts — such as 'equality' and 'fair' — drawn from the 'Fair' (virtue) 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 Rounding 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 means 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 Rounding and colleagues' (2012, Study 2) 'resource refueling' 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 Mazurs' (1987) hyperbolic temporal discounting formula (Equation 2) to the decision presented by Rounding 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 monetary amounts exceeding \$1000 (Green, Myerson, Lichtman, Rosen, & Fry, 1996; Simpson & Vuchinich, 2000; Vuchinich & Simpson, 1998). 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 an extraordinary 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 resiststhe urge to smoke cigarettes. It has been demonstrated experimentally that the value of a series of rewards are additive (Kirby, 2006). For the decision-maker, 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 social, 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 Harrison and McKay's (in preparation) finding 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 in the knowledge that excessive fat stores may be life threatening. 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 participant's 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 their 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 Harrison and McKay (in preparation) 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.

There is some extant literature that appears to lend itself to the second possibility. Images of beautiful women (Wilson & Daly, 2003), or gambling environments (Dixon, Jacobs, & Sanders, 2006) can raise participants' discounting rates. Harrison and McKay (in preparation) speculated that their moral primes increased temporal discounting rates by generating the possibility of social rewards like those described above.

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, Harrison and McKay (in preparation)—and the present work—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 2). 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 Norenzayan's (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 (in preparation) 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 post-graduate 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 / Procedure

Sessions were conducted in groups of 2 – 8 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 practise 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[1].

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

1 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).

bidder (Vickrey, 1961)[2]. 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, 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 Nielsen's (2008) recommendations, the moral connotations of the words were obscured (i.e. '*Acacias are drought tolerant*') as far as 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.

Demographics/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).

2 According to Vickrey (1961), asking the highest bidder to pay the amount of the second highest bid encourages bidders to bid what 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.

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.

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;

$$\sum(x_2 - x_1)\,[(y_2 + y_1)/\,2] \qquad (1)$$

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

Table 1: *Mean scores (SD in parentheses) for Age and Religiosity. Frequency Data for Education, Gender and Religion by Condition.*

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

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.

$$V = \frac{A}{(1 + k\mathrm{D})} \quad \text{(2: Hyperbolic model)} \qquad V = Ae^{-kD} \quad \text{(3: Exponential model)}$$

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.

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

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).†*

n	Time one (pre-priming)						Time two (post-priming)					
	\$9.90		\$29.90		Total		\$9.90		\$29.90		Total	
	Md	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)
Fair prime	.35	.44 (.05)	.63	.60 (.05)	.46	.51 (.05)	.41	.46 (.05)	.66	.59 (.05)	.49	.52 (.05)
Religious	.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.

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).*

n	Time one (pre-priming)						Time two (post-priming)					
	$9.90		$29.90		Total		$9.90		$29.90		Total	
	Md	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)	*Md*	*M* (*SE*)
Fair prime	.17	.19 (.03)	.03	.08 (.02)	.08	.12 (.03)	.12	.20 (.05)	.03	.11 (.04)	.07	.14 (.04)
Religious	.14	.36 (.13)	.05	.10 (.03)	.09	.16 (.04)	.16	.33 (.09)	.07	.12 (.03)	.18	.18 (.04)
Neutral	.26	.61 (.24)	.05	.19 (.08)	.10	.32 (.13)	.37	.44 (.09)	.06	.33 (.18)	.14	.33 (.11)

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 Harrison and McKay (in preparation), there are three possible explanations.

The decrease in intervals between testing sessions, compared to Harrison and McKay (in preparation), was designed to reduce the potential for participant's 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 Harrison and McKay (in preparation) 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 Harrison and McKay (in preparation) 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 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 Harrison and McKay (in preparation) 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 (in preparation), conducted the tasks consecutively, and did not detect an 'ego-depletion' effect.

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 increased, 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 idea to test. An item of the form "Would you like a 20% improvement in how other's 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 in social desirability biases, 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 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 (in preparation) 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 decision-maker 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 a 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, the potential to elucidate the conditions under which communicators should appeal to peoples' financial or social goals when trying to reduce impulsive behaviours will make the project worthwhile.

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Received: 3.4.2013
Revised: 3.26.2013
Accepted: 3.26.2013