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Religious Cognition and Duration of Maintained Grip

Evan C. Carter

University of Miami, evan.c.carter@gmail.com

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UNIVERSITY OF MIAMI

RELIGIOUS COGNITION AND DURATION OF MAINTAINED GRIP

By

Evan C. Carter

A THESIS

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Master of Science

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RELIGIOUS COGNITION AND DURATION OF MAINTAINED GRIP

Evan C. Carter

Approved:

Michael E. McCullough, Ph.D.
Professor of Psychology

Terri A. Scandura, Ph.D.
Dean of the Graduate School

Charles S. Carver, Ph.D.
Professor of Psychology

Terrence D. Hill, Ph.D.
Assistant Professor of Sociology

CARTER, EVAN

Religious Cognition and Duration of Maintained Grip

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Recent work suggests that the links between religious belief and behavior with a variety of positive outcomes (e.g., longer life, more marital satisfaction, scholastic achievement, better health behaviors) may be partially explained by religious belief systems' ability to foster self-control and self-regulation. The current investigation sought to explore this hypothesis by determining if induction of religious cognition (through a supraliminal religious prime) could increase behavioral self-control, operationalized as performance on a maintained grip task. Using 118 participants, the author tested whether nonconscious exposure to religious content would increase the amount of time that participants were willing to physically persist at two rounds of the maintained grip task as compared to a control group. A within-subjects trial-by-prime interaction was found (the prime appeared to cause participants to persist at the task for less time during the first trial, but not the second) and a between-subjects sex-by-prime interaction was found (on average, men given the religious prime held their grip for less time than did men in the control group, whereas no differences were found between women). Findings are discussed in terms of the link between religion and self-control and future directions are suggested.

TABLE OF CONTENTS

	Page
LIST OF TABLES	iv
LIST OF FIGURES	v
Chapter	
1 INTRODUCTION	1
Religion and Individual Well-Being	1
Religion and Individual Prosociality	4
A Self-Regulatory Explanation of Religion’s Effects	4
The Present Study	6
2 METHOD	9
Participants	9
Measures	9
Procedure	11
3 RESULTS	14
Descriptive Statistics	14
Analyses	14
4 DISCUSSION	18
Why Did the Religious Prime Reduce Men’s Maintained Grip?	19
Limitations	23
Directions for Future Research	24
Conclusion	25
References	27
Tables	34
Figures	36
Appendices	38

LIST OF TABLES

Table 1	34
Table 2	35

LIST OF FIGURES

Figure 1..... 36

Figure 2..... 37

Chapter 1: Introduction

Psychological science has long recognized the influence of religion on human behavior. Researchers who study religion have more recently begun looking closely at the specific facets of behavior with which religion is associated, including, for example, coping, health behaviors, cooperation, altruism, aggression, marital satisfaction, academic achievement, and criminal activities (Pargament, 1990; T. D. Hill, Burdette, Ellison & Musick, 2006; Norenzayan & Shariff, 2008; Bushman, Ridge, Das, Key, & Busath, 2007; Mahoney, Pargament, Tarakeshwar, & Swank, 2001; Regnerus, 2000; Baier & Wright, 2001). However, despite the volume of work produced on the subject, there are still many opportunities available for empirical and theoretical advancements in this area. McCullough and Willoughby (2009) proposed one such advancement: That religion might be related to a variety of its psychological and behavioral correlates through religious cognition's ability to increase self-control and facilitate self-regulation. In this thesis I examined that proposition, with special attention devoted to evaluating the causal nature of the religion/self-control association by priming religious cognition and measuring its effect on a maintained grip task.

Religion and Individual Well-Being

Research on religion's relationship with well-being has yielded evidence that religion is clearly related (though usually weakly, and not always in a positive direction), to several aspects of mental and physical health. For example, Witter, Stock, Okun, and Haring's (1985) meta-analysis revealed that religiosity and subjective well-being were positively correlated (mean effect size $r = .16$). Smith, McCullough, and Poll (2003), in a more recent meta-analysis, found that some measures of religiousness (e.g. intrinsic

religious motivation, positive religious coping) were negatively correlated with depressive symptoms (mean effect sizes ranged from $r = -.20$ to $-.18$). Researchers have also examined religion's influence on more specific physiological systems. For example, Seeman, Dubin, and Seeman (2003), through a review of the extant literature, concluded that religious attendance is associated with lower blood pressure, less hypertension, and better immune function. They also concluded that meditation and relaxation practices associated with traditions such as Zen Buddhism and Yoga are related to lower blood pressure, lower cholesterol, lower stress hormone levels, and better health outcomes in clinical patient populations. Furthermore, two large reviews and several more recent, carefully conducted studies have concluded that religiously active people, across several societies, tend to have 25% to 30% reductions in mortality (McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000; Powell, Shahabi, & Thoresen, 2003; Musick, House, & Williams, 2004; T.D. Hill, Angel, Ellison, & Angel, 2005; la Cour, Avlund, & Schultz-Larsen, 2006; Teinonen, Vahlberg, Isoaho, & Kivela, 2005; Yeager, Gleib, Au, Lin, Sloan, & Weinstein, 2006; Chida, Steptoe, & Powell, 2009).

Religion also appears to encourage health behaviors and social adjustment. For example, in Christian, Jewish, and Muslim populations, people with higher scores on various measures of religiousness are less likely to drink or smoke, and are more likely to wear their seatbelts, see their dentists, and take vitamins (T. D. Hill, Burdette, Ellison, & Musick, 2006; Islam & Johnson, 2003; Shmueli & Tamir, 2007; Wallace & Forman, 1998). In a meta-analytic review of 60 effect sizes, Baier and Wright (2001) found that religion is also associated with lower rates of crime, delinquency, gambling, and drug use. In addition, several recent studies have revealed that more religious youths tend to

have higher grade point averages, higher scores on standardized tests, and higher achievement test scores than non-religious youths (Regnerus, 2007; Regnerus & Elder, 2003; Jeynes, 2002). As one would expect from the summary above, religion's apparent effects extend directly into close interpersonal relationships: there is also substantial evidence that married religious adults have higher levels of marital satisfaction and commitment, and that church attendance is negatively correlated with divorce (Mahoney, Pargament, Tarakeshwar, & Swank, 2001).

Several explanations have been advanced to account for religion's associations with physical and personal well-being. For example, religion may influence such outcomes by promoting health behaviors and proscribing harmful ones (T. D. Hill, Burdette, Ellison, & Musick, 2006; Strawbridge, Shema, Cohen, & Kaplan, 2001); religion may be a particularly effective way of providing social support (Joiner, Perez, & Walker, 2002); religion may provide and promote strategies for coping with stress (Ano & Vasconcelles, 2005; Pargament, 1997); and religion may confer its benefits by socializing children and helping them to conform to society's norms (Baier & Wright, 2001). Although these mechanisms likely all play some role, George, Larson, Koenig, & McCullough (2000) estimated that these pathways accounted for only 35% to 50% of religion's apparent effects on mental, physical, and social well-being. If George et al.'s (2000) estimate is correct, then science has yet to explain, at the very least, one-half of the interesting and potentially important relationships of religion with health, well-being, and social behavior.

Religion and Prosociality

Religion appears to yield mental health, physical health, and social benefits for individual believers, but it also appears that religion is able to confer benefits to individuals within groups by facilitating such things as cooperation between non-kin. The idea that religions increase actions that are costly to the individual, but beneficial to other people, has been termed *religious prosociality* (Norenzayan and Shariff, 2008). Within their texts, all major religions encourage prosocial action (Batson, et al., 1993; Monsma, 2007), and sociological studies have consistently found that people who report frequent prayer and religious service attendance also report devoting more time and money to charities than people who are less religiously involved (Monsma, 2007; Brooks, 2006). Though the literature suggests that religious people may not live up to their self-reported degree of prosociality, as in experimental studies that measure actual offers of help, they do seem to be more prosocial when they feel their image will be affected by their actions, or when the recipients are members of their own social groups (Darley & Batson, 1973; Batson et al., 1989; Monsma, 2007; Norenzayan & Shariff, 2008). Furthermore, research has revealed that when religious concepts are primed, it is possible to increase prosocial behavior. Specifically, when offered pamphlets to distribute for a non-profit organization, participants took more if they were primed with positive religious words (Pichon, Boccato, & Saroglou, 2007), and participants were more inclined to anonymously share money with strangers when primed with religious words (Shariff & Norenzayan, 2007).

A Self-Regulatory Explanation of Religion's Effects

As noted above, McCullough and Willoughby (2009) proposed an overarching explanatory mechanism that could help to shed more light on religion's associations with

health and prosociality: The psychological processes of self-regulation and self-control. In their review, McCullough and Willoughby (2009) used Carver and Scheier's (1998) theory of self-regulation to integrate the literature to date. They organized the existing empirical literature around six basic propositions. These six propositions are that (a) religiousness can promote self-control, (b) religion influences self-regulation by influencing people's goals, (c) Religion influences self-regulation by promoting self-monitoring, (d) religion influences self-regulation by building self-regulatory strength, (e) religions influence self-regulation by prescribing and promoting mastery with specifically religious outputs for self-change, and (f) religion affects health, well-being, and social behavior through self-regulation and self-control.

One reason why it is appealing to consider the possibility that religion obtains its effects on health, well-being, and social behavior from its connection to self-control is that many of the behavioral and health correlates of religion are also correlated with self-control. In a review of the extant empirical evidence, Baumeister & Vohs (2004) concluded that high self-control was related to less alcohol and substance use, better health behaviors, better self-assessed health, and lower rates of crime and delinquency. High self-control is also related to better interpersonal relationships, better psychological adjustment, better performance on achievement-related tasks, and better academic performance (Tangney, Baumeister, & Boone, 2004; Duckworth & Seligman, 2006). The work above suggests that any mechanism that allows a person to act in his or her best long-term interests will be associated with improved outcomes in domains such as health, psychological well-being, and social functioning.

Moreover, self-control appears to be a cognitive requirement for the proximal production of prosocial behaviors--particularly those characterized by cooperation. The iterated prisoner's dilemma is a useful and classic example of how a problem of cooperation is, in fact, a problem of self-control (Rachlin, 2000). In the prisoner's dilemma, two players must decide to cooperate with or defect against each other. If both players defect, each gets a low reward; if one player defects and one cooperates, the cooperator gets the lowest possible reward while the defector gets the maximum reward; but if both cooperate, both receive a moderate-sized reward. There is temptation for a player to try for the largest reward by defecting; however, any partner will quickly catch on to a strategy of defection and, in self-defense, begin defecting as well. The inevitable outcome in this case is that both players continuously get low rewards. In contrast, if the temptation to defect can be resisted, a player can maximize his or her reward over a period of time by cooperating and encouraging his or her partner to cooperate as well. Therefore, encouraging the establishment of mutual cooperation in the iterated prisoner's dilemma relies on the same psychological processes that enable a person to study for a test or save money--self-control, or the ability to forgo a sooner, smaller reward, for a larger reward at a later time (Stevens, Cushman, & Hauser, 2005).

The Present Study

The literature to date that examines religion's connections to self-control and self-regulation has almost exclusively relied on correlational methods (McCullough & Willoughby, 2009). Therefore, there is great need for experimental research that can help clarify the causal status of the relationship between the two constructs. This thesis was an

empirical exploration of the causal nature of the relationship between religious cognition (induced through religious primes) and self-control.

Priming can be defined as activation of a concept in order to increase the accessibility of that concept during subsequent information processing—for example, when one is forming impressions of strangers (Higgins, Rholes, & Jones, 1977; Srull & Wyer, 1979) or interacting with others (Bargh, Chen, & Burrows, 1996). Recently, several techniques for experimentally manipulating cognition related to religion through priming of religious concepts have been developed (Wenger, 2003, 2004, 2007; Shariff & Norenzayan, 2007). The Scrambled Sentence task (Srull & Wyer, 1979) is a commonly used method for the supraliminal priming of concepts; and in this thesis, I adopted scrambled sentences from Shariff and Norenzayan (2007) and E. L. Uhlmann (personal communication, September 25, 2008) that prime either religious or control concepts.

Although it is possible to define self-control in several ways, for this project self-control was defined as the act of working to override a prepotent response, such as not acting on a craving for unhealthy foods, overcoming the impulse to sleep more when one is already late, or even ignoring the temptation to alleviate physical discomfort (Baumeister, Vohs, & Tice, 2007). Research has shown that this latter example of self-control is particularly relevant for smoking cessation, providing evidence that one of the major factors that predict recidivism is the desire to avoid the physical discomfort that accompanies quitting (Spring, Wurtman, Gleason, Wurtman, & Kessler, 1990; Zinser, Baker, Sherman, & Cannon, 1992). In this thesis, I used the duration of time that a participant is able to maintain his or her grip in a maintained grip task as a behavioral measure of self control. Duration of maintained grip tends to be only weakly related, if at

all, to individual grip strength, and it is a very good measure of a person's willingness to withstand discomfort (Rethlingshafer, 1942; Thornton, 1939). In addition, Muraven, Tice, and Baumeister (1998) conducted an experiment that showed that self-regulation of emotions is related to decreased time on the maintained grip task, which the authors interpreted as evidence that regulating emotions and withstanding discomfort both depend on a underlying regulatory strength that is common to all acts of self-control.

With the religious prime as an independent variable and the duration of grip as the dependent variable, it was possible to experimentally test whether behavioral self-control is increased through non-conscious exposure to religious content. I predicted that people who were exposed to a religious prime would evince greater self-control on the successive maintained grip task than would people who were exposed to a control prime.

Chapter 2: Method

Participants

Participants were 118 undergraduates (39.8% male) recruited from introductory Psychology courses at the University of Miami. Participants ranged in age from 16 to 35 years old ($M = 19.24$, $SD = 2.07$), and reported a variety of religious denominations (38.1% Catholic, 14.4% Protestant, 11.9% Judaism, 4.2% Islam, 4.2% Hinduism, 2.5% Buddhism, .8% Jainism, 10.2% no religion, and 5.9% other) and ethnicities (48.3% Caucasian, 14.4% Asian, 7.6% African American, 21.2% other, and 6.8% more than one race). 27.1% of participants considered themselves to be Hispanic. Three participants did not report their age, nine participants did not report a religious denomination, and one participant did not report an ethnicity. All participants received seven dollars and partial credit toward fulfillment of a class requirement. Data for seven participants were not analyzed for a variety of reasons: one participant reported a thumb injury that affected his performance on the maintained grip task, one participant did not complete the maintained grip task correctly, and five participants reported being aware of the religious nature of the prime (e.g., one individual concluded that I was testing whether or not people would avoid religious words when unscrambling sentences). Additionally, data for 14 participants were missing for the Religious Commitment Inventory because they did not participate in a pretesting session during which those data were collected (see below).

Measures

Length of maintained grip. We measured participant's handgrip endurance using a dynamometer (see also Magen & Gross, 2007). First, participants were asked to squeeze the dynamometer as hard as they could for three seconds. Then, the experimenter

marked 70% of the participant's maximum grip strength and asked the participant to hold the indicator above this threshold for as long as he or she could. This methodology tailors the task to participant's own baseline grip strength, thereby controlling (at least partially) individual variation in strength and helping to ensure that dependent variable measures effort, rather than grip strength alone. After this trial was completed, which is the standard administration for this task, the experimenter then asked the participant to perform the task again. Participants were all given a twenty second rest period, after which they performed the second trial of the maintained grip task. This novel modification was used to determine if the prime would also affect (a) willingness to repeat a painful task, and (b) fatigue.

Unpublished data support the claim that the maintained grip task is related to self-control: A sub-set of the current sample ($n = 65$) received a self-report trait self-control measure (the Brief General Self-Control Scale; Tangney, Baumeister, & Boone, 2004) through a separate data collection effort, and there was a significant correlation between scores on this measure and time of maintained grip during the first trial, $r = .24, p = .05$.

Religious Commitment Inventory-10. Participants were given the Religious Commitment Inventory (RCI-10; Worthington, et al., 2003) in a pretest session at the beginning of the semester. The RCI-10 is a 10-item questionnaire designed to measure religious commitment ($\alpha = .93$ in Worthington et al., 2003). This scale includes two subscales, Interpersonal Religious Commitment ($\alpha = .92$ in Worthington et al., 2003) and Intrapersonal Religious Commitment ($\alpha = .87$ in Worthington et al., 2003), and these scales are highly intercorrelated ($r = .72$ in Worthington et al., 2003). Some example items include "I spend my time trying to grow in understanding of my faith"

(intrapersonal religious commitment) and “I enjoy spending time with others of my religious affiliation (interpersonal religious commitment). Participants endorsed items on a five-point Likert-like scale, where 1 = *not at all true of me* and 5 = *totally true of me* (see appendix A).

Ratings of hand grip task. Participants completed six post-task items designed to determine how much of a challenge they perceived the maintained grip task to be (e.g., “It was difficult,” “It was stressful,” and “I wanted to stop before it was over.”), which participants endorsed using a five-point Likert-type scale, where 1 = *strongly disagree* and 5 = *strongly agree* (see appendix B).

Experimental Manipulation. In the scrambled sentence task, participants were instructed to take a series of five-word strings, eliminate one of the words, and form a grammatically correct sentence with the remaining four words (see also Srull & Wyer, 1979; Shariff & Norenzayan, 2007). Each task consisted of 20 “scrambled sentences,” and the two conditions differed only on ten of the twenty sentences. The control prime consisted of sentences that primed no consistent concept, like “shoes give replace the old,” and “toy play the active with.” The religious prime included sentences designed to prime the concept of religion, for example, “dessert divine was fork the,” and “sacred was book refer the”. All participants were told that it was important that they complete the puzzles as quickly and accurately as possible (see appendix C).

Procedure

Participants were run in individual laboratory sessions, and experimenters were matched with participants by gender. Each session occurred behind closed doors in a quiet laboratory space. When participants signed up for the study, they were told that they

were going to be in “a study of individual differences in mental and physical focus.” A double-blind, between-subject design was used, and therefore, each participant was randomly assigned to receive either the religious prime or the control prime upon arrival. The experimenter obtained informed consent from the participant and then briefly explained that he or she would perform a pair of tasks, one related to mental focus, the other related to physical focus (the “mental focus task” being the scrambled sentence task and the “physical focus task” being the maintained grip task). Importantly, other than during the grip task, the experimenter was always waiting outside of the room, and the experimenter instructed participants to minimize their talking during the laboratory session.

Immediately after informed consent was obtained and the tasks were briefly explained, the experimenter demonstrated a standardized way of sitting and holding the dynamometer. The experimenter then asked the participant to grip the dynamometer as hard as he or she could for three seconds, after which the experimenter determined the participant’s 70% threshold and marked it on the face of the dynamometer with a pencil. Then, participants received thorough directions so that the rest of the experiment could proceed with a minimum of talking. Once the experimenter was convinced the participant knew what was expected, he or she left the room so that the participant could complete the scrambled sentence task. After this task, the experimenter re-entered the room while the participant performed the first maintained grip trial. Once the first trial was completed, the experimenter asked the participant to perform a second trial. All participants complied with this request. After the second maintained grip trial, the experimenter left the room and the participant completed the six post-task items.

Following the completion of the post-task items, experimenters thoroughly debriefed participants, both explaining the purpose of the study and probing for suspicion.

Afterward, participants were paid \$7.

Chapter 3: Results

Descriptive Statistics

Means and standard deviations are reported in Table 1. Intercorrelations among all major study variables appear in Table 2.

Analyses

To insure that the experimental effects were independent of changes in how challenging the task was perceived to be across the two groups, I ran six independent samples *t* tests, one for each post-task item: “It was difficult,” $t(109) = -.48, p = .63$, “It was stressful,” $t(109) = -.39, p = .70$, “It required a lot of effort,” $t(109) = -.62, p = .54$, “I had to concentrate on the task,” $t(108) = -.70, p = .49$, “I had to force myself to keep going,” $t(108) = -.55, p = .58$, and “I wanted to stop before it was over,” $t(109) = -.45, p = .66$. Because no *t* test was statistically significant, no post-task item was used as a covariate in the primary analysis. A 2 (condition: religious prime vs. control prime) x 2 (sex: male vs. female) factorial analyses of variance (ANOVA) also revealed that there were no significant condition by sex interactions for any of these post-task ratings.

Previous work suggests that two potential moderator variables should be evaluated when examining the effects of religious primes on maintained grip. First, several studies that have involved experimental religious primes have revealed that the effects of the primes are moderated by participants’ self-reported religiosity (e.g., Wenger, 2003; Wenger, 2004; Weisbuch-Remington, Mendes, Seery, & Blascovich, 2005). Therefore, I included scores on the RCI (Worthington, et al., 2003) in the analysis. Because the distribution of the RCI was non-normal (skew = .80, kurtosis = -.38), and could not be corrected using standard transformations, the sample was split into tertiles to

create three approximately equal groups representing low ($n = 36$), medium ($n = 28$), and high ($n = 34$) religious commitment.

Second, there are very large differences in strength between men and women (Lassek & Gaulin, 2009, report that 99.9% of women have less upper body strength than does the average man), and Thornton (1939) reported that time on maintained grip, as well as similar physical tests, were most valid as a measure of withstanding discomfort when accounting for a factor he labeled “sex-strength,” which appeared to represent sex-differences in physical size and strength. To assess the sex-related strength differences in my sample, I ran frequency analyses on participants who fell above and below the mean (28.74 kg) for initial tests of grip strength. Of the 52 participants whose initial grip strength was above the mean, only 14 (26.9%) were female. Additionally, the group of participants whose initial grip was greater than one-half of a standard deviation above the mean was made up exclusively of men. Of the 59 participants whose initial grip strength was below the mean, 54 (91.5%) were female. Furthermore, a large correlation ($r = .74$) between gender and performance on the maintained grip task was found, $p < .01$ (see Table 2). Therefore, to control for such large differences in physical strength, I included sex as another factor in the main statistical analysis.

Therefore, the data were first analyzed with a 2 (condition: religious prime vs. control prime) x 2 (sex: male vs. female) x 3 (religiosity: high vs. medium vs. low scores on the RCI) x 2 (time: trial 1 vs. trial 2) repeated measures analysis of variance (ANOVA), with the amount of time (in seconds) that a participant held the indicator of the dynamometer above his or her threshold as the dependent variable. Other than a significant main effect for time, $F(1, 86) = 22.15, p = .00$, such that all participants

maintained grip for longer on trial one ($M = 24.42$, $SD = 13.69$) than on trial two ($M = 18.55$, $SD = 10.74$), this model produced no significant main effects or interaction effects. However, there was a trend toward significance for the interaction of time and condition, $F(1, 86) = 3.40$, $p = .07$, and a trend toward significance for the interaction of condition and sex, $F(1, 86) = 3.11$, $p = .08$. Since there did not appear to be any effect of religiosity, I trimmed the model by dropping all terms that included scores on the RCI from the model, resulting in a 2 (condition: religious prime vs. control prime) x 2 (sex: male vs. female) x 2 (time: trial 1 vs. trial 2) repeated measures ANOVA. It is of note that trimming the model in this way allowed me to include data from the 14 participants who were missing scores on the RCI.

In the second model, the within-subjects main effect for time remained significant, $F(1, 107) = 31.53$, $p < .001$, and the interaction of time and condition reached statistical significance, $F(1, 107) = 5.44$, $p = .02$. The simple effects for this interaction were explored by running two independent-samples t tests to determine if priming condition predicted changes in performance differently on trial one than on trial two. For trial one, according to a Levene's test for equality of variances, the error variances of the two groups were not equal, $F(1, 109) = 3.81$, $p = .05$, so to account for this difference, I used a t value that did not assume equal variances. This test, though close to conventional cutoffs for statistical significance, was not statistically significant, $t(106.92) = -1.89$, $p = .06$. The test for trial two was also not statistically significant, $t(109) = -.17$, $p = .87$. Though no test for simple effects reached significance, it does appear that the size of the effect was larger on trial one than it was on trial two, and that

those participants given a religious prime always tended to hold the grip for shorter periods than those participants given the control prime (see Figure 1).

For the tests of between-subjects effects, there was a nearly significant main effect for condition, $F(1, 107) = 3.42, p = .07$, that was modified by a significant interaction of condition and sex, $F(1, 107) = 6.85, p = .01$. This two-way interaction was decomposed by running an independent samples t test separately for men and women to evaluate whether performance on the maintained grip tasks, on average, was predicted by condition. The main effect for condition was not significant for women, $t(66) = .61, p = .54, d = .13$, but it was for men, $t(41) = -2.89, p = .006, d = -.90$, indicating that men who received the religious prime maintained their grip for less time across the two trials ($M = 18.09, SD = 10.59$) than did men who received the control prime ($M = 27.36, SD = 10.44$). These results are displayed in Figure 2.

Chapter 4: Discussion

There is enough evidence in the current literature on self-control and religion to conclude that a positive correlation exists between measures of the two constructs (for a review, see McCullough & Willoughby, 2009). Moreover, they share many correlates from many life domains, including health (Baumeister & Vohs, 2004; T. D. Hill, Burdette, Ellison & Musick, 2006), interpersonal functioning (Tangney, Baumeister, & Boone, 2004; Mahoney, Pargament, Tarakeshwar, & Swank, 2001), and performance in academic settings (Duckworth & Seligman, 2006; Regnerus, 2000). Despite the existence of an association between religiousness and self-control, however, the causal status of the religion/self-control association remains unclear. In an attempt to test the hypothesis that religion causes self-control, I investigated whether priming religious concepts would increase participants' performance on the maintained grip task—a task that requires the effortful suppression of a prepotent response (Muraven, Tice, & Baumeister, 1998).

I tested this hypothesis across two trials of a maintained grip task. I found that the religious prime did affect duration of maintained grip; however, the effect was in the opposite direction from what I had predicted, and it was moderated by sex: Men (but not women) who received the religious prime maintained their grip for significantly less time (approximately 18 seconds on average across the two trials) than did men who received the control prime (approximately 27 seconds on average across the two trials). It is notable that the men who received a religious prime did not report differences on the post-task ratings (e.g., that it was more difficult, or that it required more effort) than did men in the control condition. This finding suggests that the lower performance of the men

in the religious prime condition was not due to differences in how they consciously experienced the maintained grip task.

Why Did the Religious Prime Reduce Men's Maintained Grip?

These unexpected results prompt one primary question: What is driving the effect of the religious prime?

A self-control explanation. One possibility in keeping with the reasoning behind my initial formulation of my hypotheses is simply that religious priming reduces self-control (instead of increasing it). However, such a conclusion would contradict a considerable body of correlational research (McCullough & Willoughby, 2009) and one recent experiment showing that a religious prime increased persistence on a laboratory task (Toburen & Meier, 2010). Religion may not increase self-control, but it seems unlikely (though not inconceivable) that it reduces it.

A stereotype explanation. A second—and perhaps more plausible—explanation for the present findings comes from considering more critically the mechanisms underlying effects derived from religious priming, which have been a topic of debate in the literature for several years. Some theorists have suggested that a religious prime actually causes people to feel the presence of a supernatural agent, thereby creating reputational concerns which then cause people to act as if their actions were being evaluated (Shariff & Norenzayan, 2007). A similar effect is found in the supraliminal presentation of eye-spots (Haley & Fessler, 2005).

Another explanation for the behavioral effects of religious primes—and one that is more consistent with the pattern of published results—is that religious primes activate participants' mental representations, or stereotypes, of religious people, thereby making

behaviors associated with those representations more likely to be executed (e.g., Randolph-Seng & Nielsen, 2007; Pichon et al., 2007; Saroglou, Cornielle, & Van Cappellen, 2009). This reasoning is the most commonly used when explaining the effects of primes (religious or otherwise), and has received a large amount of empirical support (Bargh, 2006). In light of the present findings, the first account (religious primes activate reputational concerns in participants) requires too much of a logical stretch, as it is hard to imagine how inducing the experience of being monitored causes only men (and not women) to *reduce* their performance. Moreover, I know of no studies that demonstrate that religious primes do indeed increase people's feelings of being monitored. The latter account (that is, that religious primes work by activating mental representations of religious people and encouraging associated behaviors) is probably a more parsimonious one.

An explanation based on stereotypes and sex-specific interpretations of the maintained grip task. It would seem unlikely that the stereotypes that men and women possess with respect to religious people are divergent enough to explain the sex-specific effects of the prime. In contrast, it is easily conceivable that men and women did have divergent perceptions of *the maintained grip task*, and that this interpretive difference led to the results reported above. This speculation leads to a third interpretation for the effects of the religious prime that I obtained in this project: Perhaps participants, regardless of sex, understood the task as one in which they were told to display their physical abilities (the task was described as a test of "physical concentration," which is easily interpreted as related to physical abilities). As for the apparently different effect on men and women, it is possible that the prime actually produced a unified effect for both

sexes (i.e., to reduce their motivation to demonstrate their physical strength), but that the effect of the prime was visible only in men because men tend to approach opportunities to display their physical abilities with greater motivation than women. In this context, one would conclude that the religious prime sapped men's desire to withstand the pain necessary to perform on the task, presumably by activating a religious stereotype of low motivation for displaying one's physical strength. It is possible that the effect is not visible in women because of a floor effect: Women may tend to have low desire to perform in a situation in which they are told to display their upper body strength, and if that is the case, then the effect of the prime on women would be no different from how they normally behave in situations that call for displays of physical strength.

Though not empirically tested in this thesis, there is indirect evidence in the literature suggesting that men and women should be expected to differ in motivations to display their physical strength. One reason may be that physical strength and ability are generally encouraged for men. For example, there is evidence that these traits may increase the availability of sexual rewards: Women are more attracted to images of more muscular men (Frederick & Haselton, 2007), and men who are better able to perform in physically demanding tasks report having had more sexual partners (Gallup, White, & Gallup, 2007; Honnekopp, Rudolpha, Beier, Liebert, & Muller, 2007). Perhaps men are aware (consciously or unconsciously) of this connection between rewards in the sexual domain and physical strength, and this awareness is reflected in general motivations to display traits such as strength. A related possibility is that men might have had particularly high motivation to perform well on the maintained grip task because of the fact that a male experimenter administered the task, thereby (perhaps) leading to a

perception of the situation as an opportunity to display one's physical strength to a potential sexual rival (i.e., an anonymous male experimenter who was approximately the same age as the participant and a student at the participant's own university). Shows of physical strength are good signals of formidability for men, and thus, adaptive in the context of possible social conflicts (Sell et al. 2009). For these two reasons, one may reasonably expect men, in general, to have high intrinsic motivations when it comes to displays of physical strength.

If men indeed perceived the maintained grip task as a chance to show their strength, why would one expect the activation of religious concepts to reduce their desire to perform? Empirical work points to differences between religious men and non-religious men, so perhaps religions generally encourage less traditionally male attitudes and behaviors. For example, using the Masculine Gender Role Stress Scale (Eisler & Skidmore, 1987), which is designed to measure the amount of stress associated with experiencing masculine gender conflict (e.g., being in situations that require emotional expressiveness), Jurkovic and Walker (2006) found that religious men experienced significantly less stress in these situations than nonreligious men. Interestingly, religious men were most different from non-religious men when rating the stressfulness of situations in which they felt physically inadequate (e.g., "feeling that you are not in good physical condition," or "appearing less athletic than a friend"). Additionally, Weeden, Cohen, and Kenrick (2008) have shown that religious service attendance is negatively correlated with the number of past sexual partners and positively correlated with the presence of children, marriage, and the desire to start a family. Along similar lines, it has also been found that intrinsically religious men desire fewer sexual partners and report

being less willing to consent to intercourse than their less religious counterparts (Njus & Bane, 2009).

When the results I obtained are considered in light of the extant literature on religious beliefs' relationship with traditionally male traits, it appears plausible that the effect of the religious prime on men's motivation to participate in a painful display of strength was directly driven by the extent to which participants implicitly associated religion to less traditionally male traits, and thus, less motivation to display physical strength. Given the available evidence, I believe that this is the best interpretation; however it is entirely possible that other explanations (e.g., that the religious prime caused men to be more humble or docile) may, in the end, be correct. Obviously, all of these interpretations are highly speculative at this point, and should be tested head-to-head (if possible) in future experiments.

Limitations

The results involving men were derived from a total of 43 people, and it is possible that the findings are due to type I error and would disappear if more participants were added. Studies with greater statistical power, and an independent replication of these current results, would be a prudent way to advance this research so as to avoid building an entirely new line of research around a solitary finding that might, in fact, be spurious. Additionally, as noted above, the explanation that I have advanced for these findings is not testable within the data I have collected in this thesis. Future efforts should include measures designed to capture the proposed moderators or mediators (e.g., measures of participants' perceptions of the connection between religiosity and strength, items designed to tap into how participants perceive the maintained grip).

Also, to my knowledge, the religious words in the primes that I used for this project were not constructed through a careful pilot study, as is often the case when priming materials are created (e.g., Randolph-Seng & Nielsen, 2007). This means that it is somewhat unclear exactly what concept was primed when participants were exposed to the scrambled sentences.

Directions for Future Research

There are several ways that the paradigm I used in this experiment could be modified so as to more precisely investigate the connection between religion and self-control. First, if my interpretation for the results obtained here is correct, and if participants implicitly believe that religious people tend to be highly self-controlled (or at least to highly value self-control), then explicitly framing the task as one that measures self-control should eliminate the pattern of results reported above, and perhaps even reveal the pattern of results that I had initially hypothesized.

If results such as those I have obtained here, and those that others have obtained using religious primes (e.g., Shariff & Norenzayan, 2007; Randolph-Seng & Nielsen, 2007; Pichon et al., 2007; Saroglou, Cornielle, & Van Cappellen, 2009) can best be interpreted as evidence that the religious primes work by activating religious stereotypes (see Randolph-Seng & Nielsen, 2008, for a defense of such a view), then the religious priming manipulation that I and others have used will never be adequate for researching the causal flow between religion and self-control (or any other variable). Future work should focus on determining whether results derived from religious primes truly only reflect the implicit beliefs about religion in the sample, or whether they create effects by working on some other level (e.g., by influencing people's perceptions that they are being

monitored by a higher power; Norenzayan & Shariff, 2008; Shariff & Norenzayan, 2007).

Additionally, there may be other options for manipulating religious mental content. For example, having participants pray in session (e.g., Lambert et al., 2009), having participants write an essay about their religious beliefs, or perhaps even having participants discuss their own religious beliefs with an interviewer may be alternate ways to experimentally increase the saliency of religious thought without simply influencing behavior through the activation of stereotypes. It may also be beneficial to approach the problem from the other direction by working to increase self-control and then measuring any consequent changes in religiosity.

Conclusion

I believe the most tenable explanation for the findings I obtained here is that men in the control group performed as they did because of a sex-specific psychological heuristic that doing so would be beneficial on average (perhaps due to evolved concerns with intra-sex aggression and/or mate choice), and that the religious prime altered the operation of this evolved psychology by activating general mental representations of religion, which very likely includes a stereotype that puts a low premium on displays of physical strength. In women, I assume that the absence of significant differences in maintained grip duration across groups are reflective of initial low motivations, due more to the lack of an evolved psychology that calls for displays of physical strength, as opposed to the prime having been ineffectual.

In retrospect—and now that I understand better the literature on the behavioral effects of implicit primes via their tendencies to activate stereotypes (e.g., Bargh, 2006)

—it is difficult to see how the present findings help to illuminate the direction of the causal flow between religiosity and self-control. Nevertheless, these results do show an interesting effect of religious priming that is quite different from the other behaviors that have been reported in the research literature (e.g., generosity; Shariff & Norenzayan, 2007; honesty; Randolph-Seng & Nielsen, 2007; and submission; Saroglou, Cornielle, & Van Cappellen, 2009). Moreover, the current results imply some clear future directions for improving research methods in this area and for understanding the effects of religious primes on behavior (Randolph-Seng & Nielsen, 2008; Bargh, 2006) more generally.

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Table 1

Descriptive Statistics for All Major Study Variables.

Variable	<i>M</i>	<i>SD</i>
Maximum Grip	28.74	12.03
Grip1	24.42	13.69
Grip2	18.55	10.74
Difficulty Rating	2.52	1.07
Stressfulness Rating	1.68	0.88
Effort Rating	2.96	1.25
Concentration Rating	3.48	1.11
Use of Force Rating	3.21	1.33
Desire to Stop Rating	2.21	1.27
Religious Commitment Inventory	1.98	0.85

Table 2

Intercorrelations for All Major Study Variables.

	Maximum Grip	Grip 1	Grip 2	Difficult	Stressful	Effort	Concentrate	Force	Stop	Sex
Max. Grip	--									
Grip 1	-.05	--								
Grip 2	-.18**	.61**	--							
Difficult	-.03	.04	.02	--						
Stressful	-.05	.13	.06	.41**	--					
Effort	-.07	.17	.18	.65**	.45**	--				
Concentrate	.02	.16	.13	.38**	.22*	.50**	--			
Force	-.08	.32**	.21*	.46**	.34**	.55**	.48**	--		
Stop	-.07	.25**	.14	.42**	.36**	.41**	.20*	.56**	--	
Sex	.74**	.11	.06	-.13	-.02	-.04	-.08	-.11	-.04	--
RCI	-.04	-.03	.11	.02	.06	-.01	-.12	.03	.15	-.01

Note. RCI = Religious Commitment Inventory; * $p < .05$, ** $p < .01$.

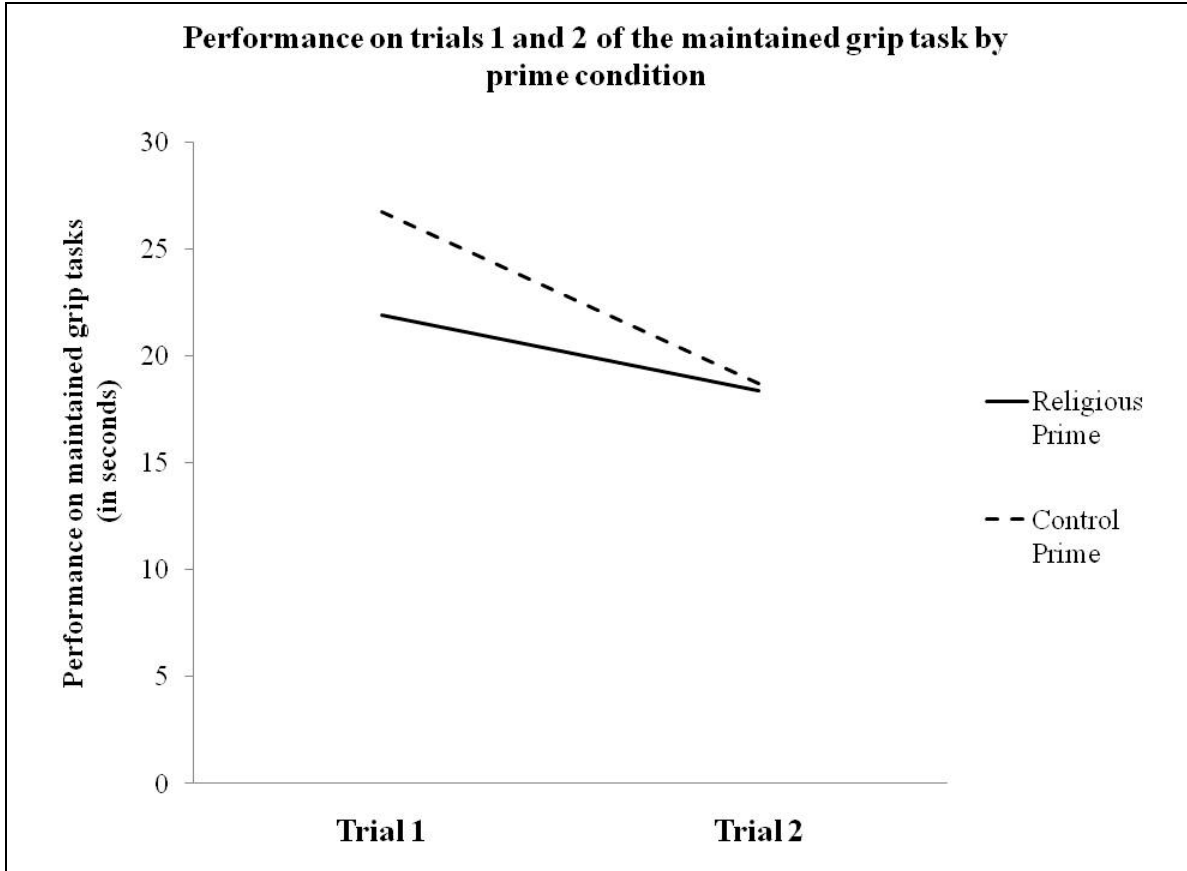


Figure 1. Performance on trials 1 and 2 of the maintained grip task by prime condition. Though the interaction between time and prime condition was significant, no significant differences were observed between means for either Trial 1 or Trial 2

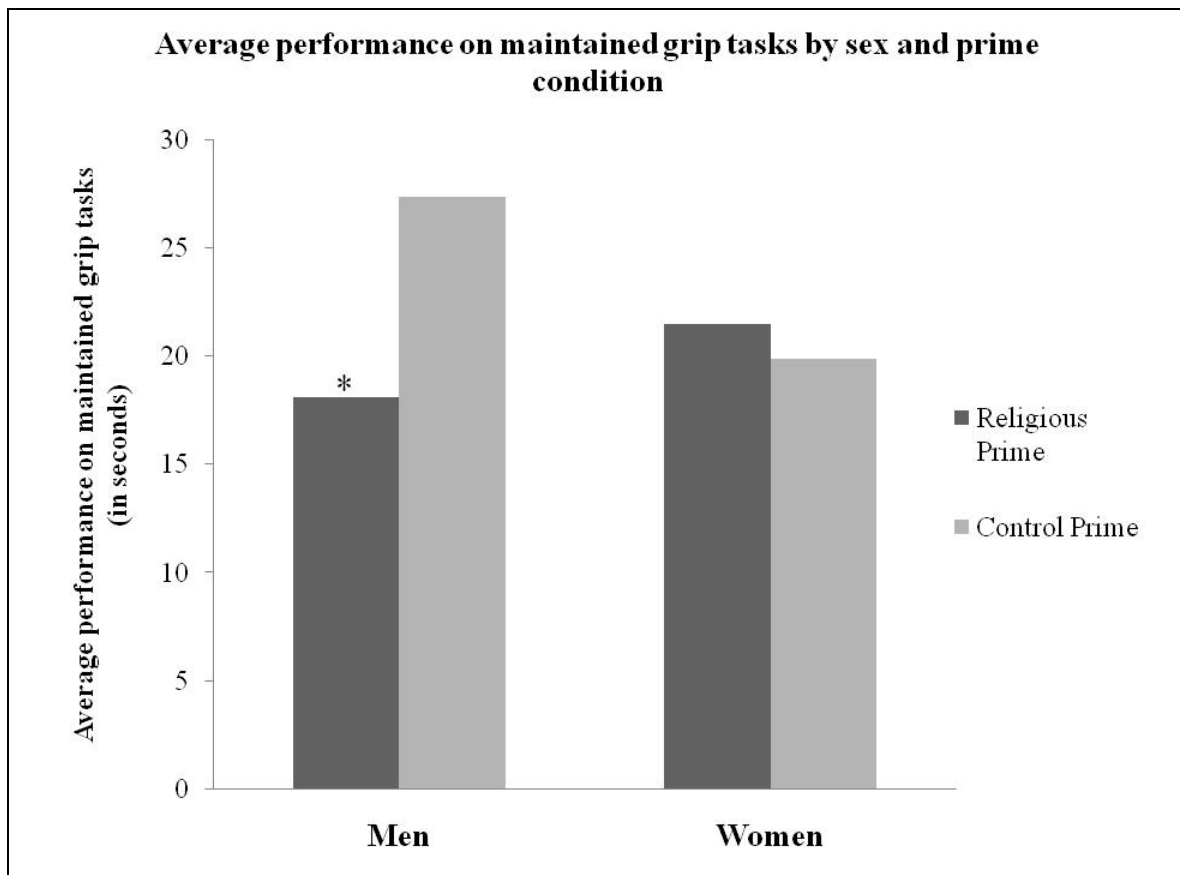


Figure 2. Average performance on maintained grip tasks by gender and prime condition. *Significantly different from corresponding control group, $p < .01$.

Appendix A

Please indicate how true the following items are for you.

1=not at all true of me 2=somewhat true of me 3=moderately true of me 4=mostly true of me 5=totally true of me

1. I often read books and magazines about my faith. 1 2 3 4 5
2. I make financial contributions to my religious organization. 1 2 3 4 5
3. I spend time trying to grow in understanding of my faith. 1 2 3 4 5
4. Religion is especially important to me because it answers many questions about the meaning of life. 1 2 3 4 5
5. My religious beliefs lie behind my whole approach to life. 1 2 3 4 5
6. I enjoy spending time with others of my religious affiliation. 1 2 3 4 5
7. Religious beliefs influence all my dealings in life. 1 2 3 4 5
8. It is important to me to spend periods of time in private religious thought and reflection. 1 2 3 4 5
9. I enjoy working in the activities of my religious organization. 1 2 3 4 5
10. I keep well informed about my local religious group and have some influence in its decisions. 1 2 3 4 5

Appendix B

Post Task Questions

Please tell us, using the scale next to each item, what you thought of the task you just completed.

	Strongly disagree 1	2	Neither Agree nor disagree 3	4	Strongly agree 5
1. It was difficult.					
2. It was stressful.					
3. It required a lot of effort.					
4. I had to concentrate on the task.					
5. I had to force myself to keep going.					
6. I wanted to stop before it was over.					

Appendix C

Scrambled Sentence Task: Religious Priming Condition

Please complete the following task. Do your best to complete every item

Instructions:

Unscramble the following groups of words to make a four word phrase or sentence by dropping the irrelevant word.

Ex: flew eagle the ~~roek~~ around

The eagle flew around.

1. felt she eradicate spirit the

2. dessert divine was fork the

3. retrace good have holiday a

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

11. lord ball almighty the was

12. coupons here phone redeem your

13. face angelic paper is her

14. drink topography water gallons of

15. the righteous water women were

16. the was composition light forest

17. her them check salvation for

18. the blue literature is curtain

19. grace he plays well notes

20. legacy eternal bell there is

Scrambled Sentence Task: Control Condition

Please complete the following task. Do your best to complete every item

Instructions:

Unscramble the following groups of words to make a four word phrase or sentence by dropping the irrelevant word.

Ex: flew eagle the rock around

The eagle flew around.

1. fall was worried she always

2. shoes give replace old the

3. retrace good have holiday a

4. more paper it once do

5. send I over it mailed

6. saw hammer he the train

7. yesterday it finished track he

8. toy play the active with

9. sky the seamless blue is

10. prepared somewhat I was retired

11. is rainbow east the ground

12. is my blue bed comfortable

13. love cup ice cream I

14. drink topography water gallons of

15. growing time now are flowers

16. the was composition light forest

17. the brown clown chair is

18. the blue literature is curtain

19. pencil children ponies rode the

20. these supersede things are hot
