The Effects of Self-Control on Subsequent Purchasing Decisions

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Abstract

The effect of self-control on individual behavior has long been a subject of debate. The psychology literature has advanced three theories to explain self-control. However, those theories carry contradictory predictions as they were restricted to linear relationships between an initial act of self-control and subsequent self-control ability. This study uses biometric measures collected in a random assignment experiment to look at possible non-linear effects. This was done by considering the variation in the effect of an initial self-control task on purchasing decisions as compliance rates with the task change. There is strong evidence pointing towards the conclusion that the self-control theories are not mutually exclusive and are actually operating simultaneously. Specifically, moderate self-control exertion in the initial task was tied to the knowledge structure and higher self-control ability in subsequent purchasing decisions. On the other hand, exerting self-control beyond a certain threshold caused a fatigue effect, which made the resource depletion models more dominant and resulted in lower self-control ability in subsequent purchasing tasks. This result was robust across several model specifications. Moreover, data from brain activation capturing approach behavior in the prefrontal cortex conformed to those findings. Finally, it seems that males were not only able to access the knowledge structure more quickly than females, but they also had higher fatigue thresholds and were able to withstand higher levels of self-control in the initial task before resource depletion became dominant.

JEL Classification: C91

Keywords: Self-Control, Knowledge Structure, Resource Depletion, Non-linear Effects

Everyday people have to struggle to make decisions that are considered to be rational or optimal, and most of these decisions (including economic choices) require the exertion of self-control. The impact of self-control on individual decision-making has been extensively researched by various disciplines, which view its effects from completely different angles. On one hand, health researchers report that self-control predicts psychiatric disorders and unhealthy behaviors, such as overeating, smoking, unsafe sex, and noncompliance with medical regimes (Tangney et al. 2004, Vohs et al. 2008; Junger and van Kampen 2010). On the other hand, sociologists state that low self-control predicts unemployment (Moffitt et al. 2013), while criminologists consider self-control as the main cause of criminal actions (Gottfredson and Hirschi 1990) and economists argue that self-control predicts overspending and debt (Gathergood and Weber 2014; Shah et al. 2012). Moreover, neuroscientists study self-control as an executive function carried out in the brain's frontal cortex, which is a region associated with motivational behavior (Davidson 2004).

Despite the scientific effort to explain the role of self-control on human decision-making, the underlying nature of self-control is still a subject of debate. In fact, there is a controversy in the psychology literature surrounding the mechanism through which self-control affects individual behavior, with three competing theories. The first theory, called the *'strength model'*, states that self-control is a *skill* that can only be acquired through repeated practice; improvements in self-control would then be noticed only in the long-run (Muraven et al. 1999; Muraven and Baumesiter 2000; Oaten et al. 2006; Gailliot et al. 2007; Oaten and Cheng 2007; Hagger et al. 2010; Muraven 2010; Wang et. al 2015). The second theory views self-control as a *'knowledge'* structure, in which an act of self-

control activates subsequent operation of self-control (so an initial act of self-control increases self-control in subsequent actions) (Baumeister et al. 1998). The third theory, known as the *'resource depletion model'*, states that acts of self-control require the exertion of energy, and when that energy is depleted, subsequent acts of self-control are impaired (analogous to muscle fatigue) (Vohs and Heatherton 2000; Muraven and Baumesiter 2000; Muraven and Slessareva 2003; Vohs and Faber 2007; Mead et al. 2009, Barnes et al. 2011; Gino et al. 2011). In all three models, the initial act of self-control exerted by the individual does not have to be related to the subsequent acts of self-control. For example, if an individual exerts self-control by refraining from smoking, this can alter subsequent self-control needed to exercise or stop eating junk food. Although most human daily decisions required the exertion of self-control, there is no conclusive evidence supporting exclusively one of those three theories.

The self-control literature is far from agreement, with assertions of either a positive, negative, or neutral effect of an initial act of self-control on subsequent self-control ability. This provides at least some partial support in favor of each of the three self-control theories mentioned above. In order to address this longstanding controversy, a random assignment experiment was conducted to determine the true impact of an initial act of self-control on subsequent purchasing decisions. While all previous investigations were restricted to linear relationships since individuals randomly assigned to self-control tasks are assumed to fully comply and be similarly affected by the task, we relax this assumption by incorporating neurophysiological responses. Our study relaxes this assumption by by obtaining individual level quantitative measures of self-control, thus allowing for potential non-linear relationships. This was done in order to shed more light

on the dynamics surrounding the relationship between self-control exertion and subsequent purchasing decisions. To that end, biometric measures, including eye tracking and brain activity, were used to quantitatively measure individual level compliance levels of subjects with the initial self-control task.

The results indicate a dual effect of an initial self-control act on purchasing decisions. Interestingly, our results show that the three self-control models operate simultaneously instead of separately, where the effects of the dominating model surfaced depending on the amount of self-control exerted in the initial task. Specifically, self-control exertions under an *easy* and short condition in the initial task were enough to activate the knowledge structure and help the subjects better control themselves in the subsequent purchasing task. However, a *hard* self-control condition showed there is a threshold of self-control beyond which the effects of the resource depletion become dominant as the subjects start getting fatigued. Rather than providing support for one of the theories of self-control, our results reconcile divergent results in the literature by proposing a unified single model of self-control and testing it empirically. Had neurophysiological measures not been collected the conclusions would have been very different. The outcome of this article highlight the relevance that new technologies such as eye tracking and EEG can play in advancing our understanding of human behavior.

There were some slight gender differences concerning how the knowledge structure and resource depletion models interacted to determine the effect of the initial self-control task. It seems that males were not only faster at acquiring the knowledge necessary to improve their short-run self-control ability following the initial task, they also fatigued slower, which means that they had both lower knowledge and fatigue

thresholds than females. Moreover, results from brain activation, measured in terms of a frontal asymmetry index (FAI) that captures *approach behavior* towards purchasing decisions were in line with the hypothesis that both the knowledge structure and resource depletion were working together. While subjects in the baseline condition had significantly higher frontal asymmetry index readings for purchases compared to non-purchases, the difference was insignificant for subjects in the easy self-control condition. This means that subjects in the easy self-control condition were enjoying a higher ability to control themselves as shown by a reduced approach behavior in the frontal cortex. Finally, compliers in the hard self-control condition showed similar approach behavior to those in the baseline condition, indicating that possible fatigue from over exertions of self-control in the initial task made the effects of the resource depletion model more salient, which led to a decrease in the self-control ability of those subjects.

The rest of the paper is organized as follows: Section 2 describes the experimental design and procedures. Section 3 and 4 cover biometric data acquisition and analysis, followed by a discussion of the results in section 5. The last section summarizes the main findings and concludes.

Methodology and Procedures

A total of 119 right-handed subjects participated in the study (57 males and 62 females). Subjects were undergraduate students at Texas A&M University, who ranged from 18 to 26 years of age (M = 20 years). The data was collected over the period from September, 2015 through May, 2016. The experiment consisted of a between-subject design, in which participants were randomly assigned into one of three conditions: 1) baseline condition, 2) easy self-control condition, and 3) hard self-control condition. While

participants in all conditions completed a purchasing task, those in the two self-control conditions were asked to perform a self-control task by sitting through a video prior to making any purchasing decisions[1]. Subjects in the easy self-control condition were presented with a 6-minute video which consisted of motion picture with varying shapes and colors. Subjects were asked to fix their gaze on a red dot bulls-eye inside a circle located at the bottom of the screen while the video was playing. In order to maintain the subjects' attention, background music with varying frequencies played throughout the video. Participants in the hard self-control condition were required to sit through the same video except that the duration of the video was 30 minutes instead of 6 minutes. Again, the subjects in this condition were asked to keep their eyes on the red dot bulls-eye during the video.

Upon arriving to the assigned session, the participant filled out an informed consent form, after which he completed a short demographic/behavioral survey. Electrodes were then attached to the subject's scalp and he was seated on a chair in front of a computer containing an eye-tracking device and a web camera. Each session lasted between 60 to 90 minutes depending on which treatment was being conducted. First, the participant received general instructions about the experiment. Depending on the randomly assigned condition, the subject was either presented with one of the two self-control tasks or went straight to the purchasing task[2].

The purchasing task included 80 trials, preceded by 10 practice ones. Each trial consisted of a fixation point presented for 2 seconds (s), followed by a stimulus (product image) (6s), a choice decision, and an inter-stimulus (6s). In each choice decision, participants were endowed with $5 and asked to choose whether they would like to

purchase the presented product or keep the money. The 80 products used in this task were classified into four categories (20 products/category): 1) Food, 2) Office supplies, 3) Health-personal care, and 4) Home appliances. All products were similar in price, with each valued at around $10. The task was incentivized and four out of the eighty purchasing decisions were randomly chosen at the end of the session to be binding. In each binding decision, subjects received the product if they chose to purchase it or $5 cash otherwise. A bingo cage containing 80 balls was used to select the binding decisions.

Biometric Data Acquisition

While subjects perform the purchasing decision task, their brain activity was measured using an electroencephalogram (EEG) and their eye movements were recorded using an eye-tracking device.

EEG data

First, the participant was fitted with a proper size headset (B-Alert X10, Advanced Brain Monitoring, Inc.) with 9 electrodes to record brain activity from the prefrontal (F3, F4, FZ), central (C3, C4, CZ), and parietal (P3, P4, POZ) cortices. An electrode impedance test was performed to ensure proper conductivity of the electrodes ($\text{impedance} < 40\text{k}\Omega$). Moreover, to guarantee the accuracy of the EEG data collection, a metric benchmark consisting of three choice, one psychomotor, and one auditory psychomotor vigilance tasks was created for each subject prior to the experiment. During data collection a 0.5 Hz high pass and 45 Hz low pass filters were used. The data collection was controlled by iMotions software and all signals were sampled at a rate of 256 Hz.

Eye-tracking data

A Tobii TX300 eye tracker was used in this experiment. This device, which was embedded in the computer screen, utilizes near-infrared technology along with a high-resolution camera to track gaze direction (Ramsoy 2015). iMotions software was used to collect the eye-tracking data at a sampling rate of 120 Hz. The desk where the computer was placed was adjusted and a calibration test was completed for each participant to make sure that his eyes were properly captured by the eye tracker.

Biometric Data Reduction and Analysis

For each trial the EEG data was split into 80 epochs, each lasting 2.5 seconds (0.5 seconds prior for baseline correction and 2 seconds after the stimulus onset). For each epoch, the frontal asymmetry index was calculated using the mid-frontal sites (F3 and F4) by taking the natural log of the alpha power on the right minus the natural log of the alpha power on the left (Allen et al. 2004; Ravaja et al. 2013). Higher values of this index are associated with a greater activation in the left prefrontal cortex and vice versa. Hence, observing a higher alpha asymmetry index indicates more approach motivation. Ravaja et al. (2013) find that the FAI is a good predictor of purchasing behavior with more approach behavior when participants purchased the products.

Results and Discussion

Compliance with Self-Control Task

Table 1 presents the compliance rate of subjects with the self-control task, taken as the fraction of the total video time that the subjects actually kept their gaze on the red bulls-eye and away from the video. The results are broken down by treatment and gender. As we can see, the average compliance with the self-control task was high in general, however, it was higher for the easy self-control condition than it was for the hard self-

control condition. This result is straightforward since it is easier to focus ones attention on the red dot bulls-eye for 6 minutes than it is to perform the same task for 30 minutes. Moreover, the compliance levels of males and females are almost identical in treatment 1 (χ^2 test, p-value=0.95) and treatment 2 (χ^2 test, p-value=0.929). The median compliance rate, for both treatments, was calculated and used to split the subjects into two categories ("High-Compliers" and "Low-Compliers")[3]. Anyone with a compliance rate greater than or equal to the median was considered a high-complier, while everyone with compliance rate less than the median was placed among the low-compliers.

Table 1. Self-control Compliance by Treatment and Gender

	Treatment 1			Treatment 2		
Self-Control Compliance	Total n = 44	Male n = 20	Female n = 24	Total n = 42	Male n = 21	Female n = 21
90% or more	26	13	13	14	8	6
80% - 89%	8	3	5	8	4	4
Less than 79%	10	4	6	20	9	11

Effect of Self-Control on Purchasing Decisions

The purchasing rate, which represents the average proportion of purchases made by the subjects, was calculated for each condition (Baseline, Low Self-Control, and High Self-Control). Figure 1 shows the results broken down by gender. As is clear from first glance, the purchasing rate was lower in the treatment conditions compared to the baseline condition. The differences are in fact significant for both males and females, which means that this initial analysis provides evidence in favor of the knowledge structure model of self-control. In the absence of a more refined measure of the extent of self-control exertion, one would be led to conclude that performing the 6 minute and 30 minute self-control tasks has gained the participants access to the knowledge required to exercise self-control in subsequent purchasing task. Moreover, the decrease in purchases

between the baseline and easy self-control conditions was smaller for females than males. This suggests that although the knowledge structure model applies to both genders, females require higher exposure to self-control before they can access that knowledge.

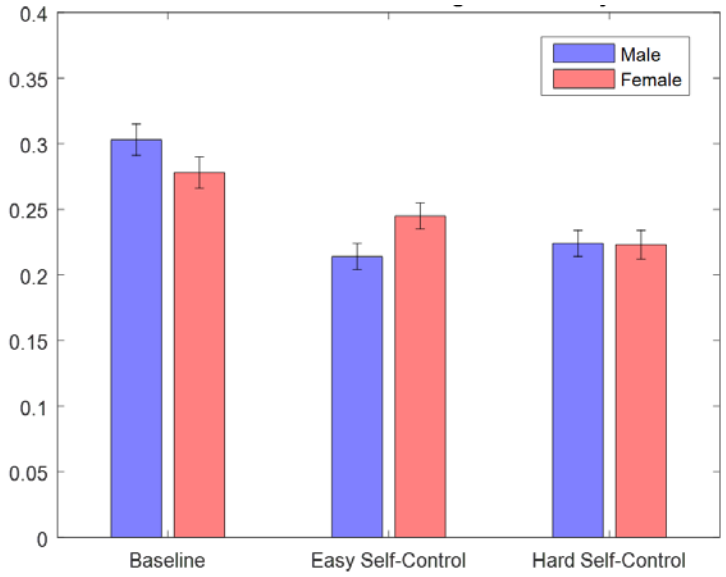

Figure 1. Effect of Self Control on Purchasing Decisions by Gender

An important issue to consider when measuring the average treatment effect is the compliance of the subjects with the treatment. The question then is how much are the results affected by compliance rate? Using biometric data from the eye-tracker enables us to tackle this question directly by measuring the average treatment effect at the individual level and comparing low-compliers and high-compliers separately. Figure 2 shows the overall purchasing rate in the three conditions and breaks down the results for high-compliers and low-compliers. While using the overall sample of participants reveals an almost identical effect for both treatments, results from the subsample of high-compliers show that purchases were significantly higher ($P = 0.008$) in the hard condition compared to the easy condition, indicating that subjects were less able to control themselves following the hard self-control task compared to the easy one. This finding provides

suggestive evidence favoring some sort of non-linearity in the effect of self-control. Although engaging in an act of self-control helps the subject better control himself initially, there seems to be a certain threshold of self-control exertion beyond which the subject's ability to control himself deteriorates as he starts feeling depleted.

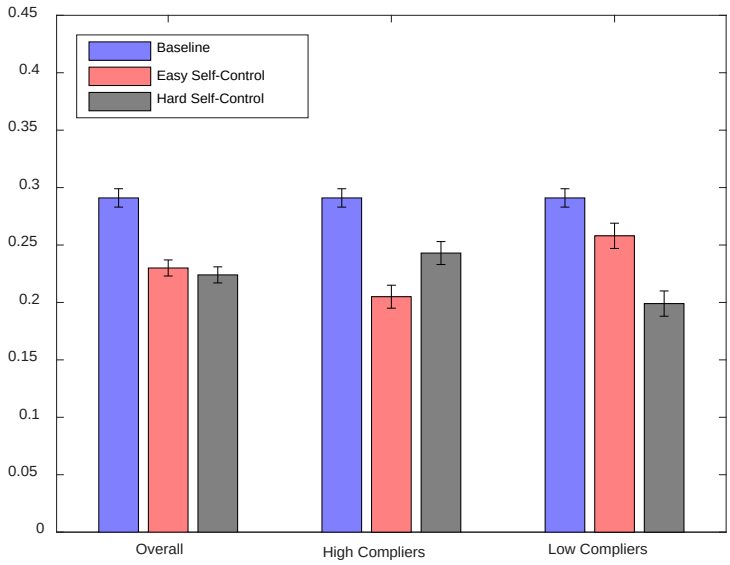

Figure 2. Effect of Self-Control and Compliance on Purchasing Decisions

Looking at the results for low-compliers, we can see that participants in both treatments made significantly less purchases compared to the baseline condition ($P < 0.02$). However, the decrease in purchases was larger for the hard self-control condition. This result looks reasonable since the low level of compliance with the hard self-control task might have kept the subjects below the fatigue threshold, in the region where the effect of the knowledge structure was still dominant. Furthermore, while the level of self-compliance was low in both treatments, the absolute level of self-control exerted in the 30 minute video is significantly higher than that in the 6 minute video, which explains why the decrease in purchases was more pronounced for non-compliers in the hard self-control task.

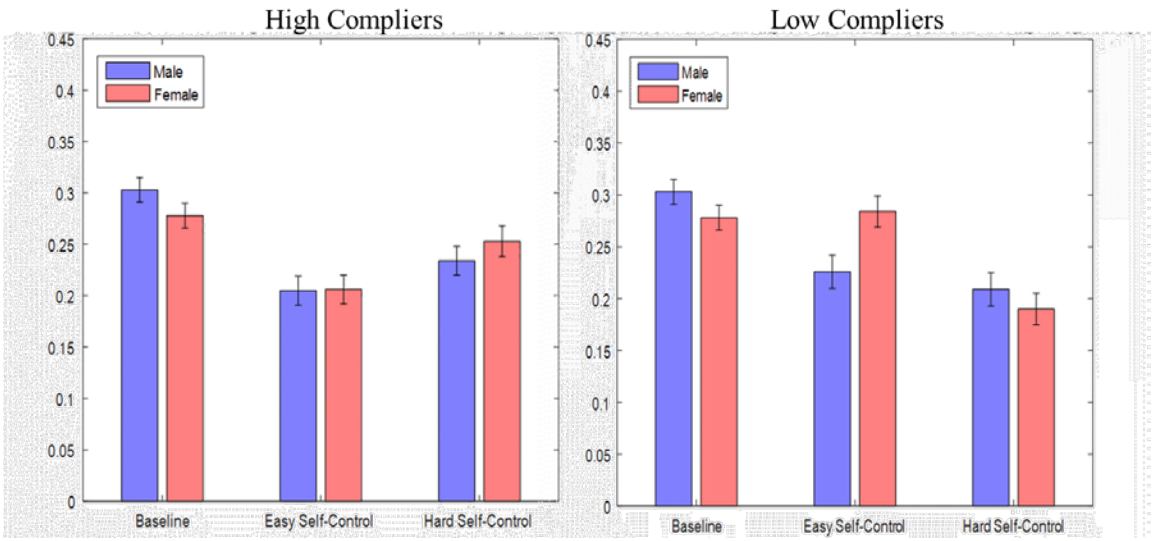

Figure 3. The Effect of Self-Control by Gender and Compliance

Results for high-compliers and low-compliers are displayed by gender and treatment in Figure 3. For high-compliers, the effects of the self-control tasks are similar across gender. Both males and females showed signs consistent with the knowledge structure in the easy self-control condition and resource depletion in the hard self-control condition. For both genders, purchases decreased significantly in the easy self-control condition compared to the baseline ($P < 0.001$), but then increased in the hard self-control condition compared to easy condition. However, there are two important things to note here. First, the decrease in purchases between the baseline and easy self-control conditions was more pronounced for males than females, presenting further support to the conjecture that females require higher exposure to self-control than males before they can access the knowledge required to help them better control themselves, at least when it comes to purchasing decisions. Second, while the increase in purchases between the easy and hard self-control conditions was significant for females ($P = 0.022$), it was insignificant for males ($P = 0.123$). This indicates that the fatigue threshold for males is

higher than the one for females. So not only are males faster at acquiring the necessary knowledge that permits more self-control, they also fatigue slower than females. Our current conjectures concerning the difference in the effect of self-control across genders are strengthened by the results from the subsample of low-compliers. As we can see in Figure 3, low-compliers who are females made almost identical purchases in the baseline and easy self-control conditions, while male low-compliers had significantly lower purchases in the easy self-control condition compared to the baseline ($P < 0.001$). This stands as yet another evidence in favor of the hypothesis that the threshold of self-control exertion required to gain access to the knowledge structure is lower for males than females. Moreover, non-compliers from both genders made significantly less purchases in the hard self-control condition compared to the baseline ($P < 0.001$). Again, this result is explained by the fact that even low compliance rate in the hard self-control task translates to an absolute level of self-control that is high enough to turn on the switch of knowledge for the subjects.

Table 2 presents logit regressions estimated to capture the effect of self-control on purchasing decisions. In order to get a more informative measure, the actual value of self-control exertion ("Self-Control Time") was used as the explanatory variable in the regressions. This was calculated by multiplying the compliance rate with the total video time and it represents the total amount of time that the subject spent in compliance with the self-control task, which varies between zero and 30 minutes. In addition, and based on the current evidence favoring non-exclusivity of the self-control models, a quadratic functional form (with respect to self-control) was specified in order to account for potential non-linear effects.

The model in the first column was estimated using only Self-Control Time as the explanatory variable, while in the second column, the non-linear effect of self-control was investigated by including the quadratic form of the variable. The regression in the third column controlled for gender, and the one in the fourth column included the interactions between gender and the self-control time variables. Finally, the regressions in the fifth and sixth columns control for demographic and behavioral characteristics.

The estimation results are consistent across all specifications of the model and tell a story similar to the one inferred from the previous analysis. As we can see, the coefficient on self-control time was negative and significant across all specifications, while the coefficient on the quadratic form of this variable was positive and significant. This result indicates that, at first, self-control has a negative effect on the likelihood that subjects will purchase products, supporting the knowledge structure hypothesis. However, subjects become fatigued as they exert self-control beyond a certain threshold, which leads to a decrease in their ability to control themselves and an increase in the likelihood that they will purchase more products. Moreover, the coefficients on gender and the interaction between gender and self-control time squared was negative and significant. This result is in line with the one in Figure 3 and suggests that not only are males less inclined than females to purchase products at first, they also have higher fatigue thresholds and are able to maintain self-control for longer periods of time than females.

Table 2. Logit Regressions of the Effect of Self-Control on Purchasing Decisions.

	[1]	[2]	[3]	[4]	[5]	[6]
Variable	Parameter	Parameter	Parameter	Parameter	Parameter	Parameter
Self-Control Time	(0.0640) ***	-0.252 ***	-0.215 ***	-0.257 ***	-0.096 ***	-0.102 ***
	(0.0020)	(0.008)	(0.008)	(0.011)	(0.010)	(0.015)
Self-Control Time Squared	-	0.008 ***	0.007 ***	0.008 ***	0.003 ***	0.003 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	-	-	-0.504 ***	-0.833 ***	0.023	-0.031
			(0.040)	(0.054)	(0.050)	(0.076)
Male*Self-Control Time	-	-	-	0.159 ***	-	0.015
				(0.019)		(0.021)
Male*Self-Control Time Squared	-	-	-	-0.005 ***	-	0.000
				(0.001)		(0.001)
Demographics/Behavioral characteristics						
Medium Income	-	-	-	-	0.154 **	0.159 **
					(0.065)	(0.065)
High Income	-	-	-	-	-0.124 *	-0.122 *
					(0.066)	0.067
Smoke	-	-	-	-	0.284 **	0.302 **
					(0.124)	(0.123)
Sleep	-	-	-	-	-0.101 ***	-0.099 ***
					(0.104)	(0.011)
Exercise	-	-	-	-	-0.04 **	-0.037 *
					(0.020)	(0.020)
Observations	9,600	9,600	9,600	9,600	9,440	9,440
AIC	11,792	11,110	10,947	10,858	10,421	10,424
BIC	11,799	11,124	10,969	10,894	10,478	10,496
Log-Likelihood	-5,895.17	-5,552.96	-5,470.58	-5,424.24	-5,202.50	-5,202.04

Notes: Medium income represents a dummy variable indicating subjects with a yearly income level between $50,000 and $149,999; and high income is a dummy variable indicating subjects with an income of $150,000 or more.

The regressions in columns 5 and 6 capture the impact of some demographic and behavioral characteristics such as the level of income, the frequency of exercise, hours slept during the previous night, and whether the subject is a smoker. The coefficient on high income is negative and significant, indicating that higher income individuals (annual income > $150,000) are better able to control themselves than lower income individuals. This result supports the evidence that poorer individuals have a higher tendency to overspend (Dobie and Skiba 2013). Furthermore, it was found that smokers have a higher propensity to purchase products than non-smokers, which points towards the reasonable conclusion that smokers have lower self-control levels compared to non-smokers. The result surrounding the effect of exercise on self-control is interesting since it carries some implications on the possible long-run effects of self-control. It was found that people who exercise on a regular basis have a higher tendency to exercise self-control.

Although further investigation is required before we can assert anything, one plausible explanation of this result is that people who exercise regularly exert self-control more frequently and over the the long-run, might have developed a skill to control themselves better than those who do not exercise regularly. This idea is in line with recent findings by Wang, Rao and House (2016) who in a natural experiment find that self-control can develop in adult populations as a result of exercising routine behaviors in commonly occurring environments. Finally, the effect of sleep on self-control is not surprising since the coefficient on this variable was negative and significant. It is expected that people who slept more hours during the previous night are relatively more rested and have higher energy, which means that they were better conditioned to access the knowledge structure and fatigued less easily than those who slept fewer hours.

The results of columns 2 and 6 were used to calculate the predicted probabilities of purchase as a non-linear function of self-control time. The results are shown in figures 4. As the figure shows, the fitted lines follow a U-shape in both Figures. This stand as clear evidence which further supports the previous hypothesis that self-control exertion turns on the knowledge structure at first, but that subjects eventually get depleted after exerting self-control beyond a certain threshold. In fact, it appears that the fatigue threshold is consistent in both specification and is somewhere around 16 minutes[4].

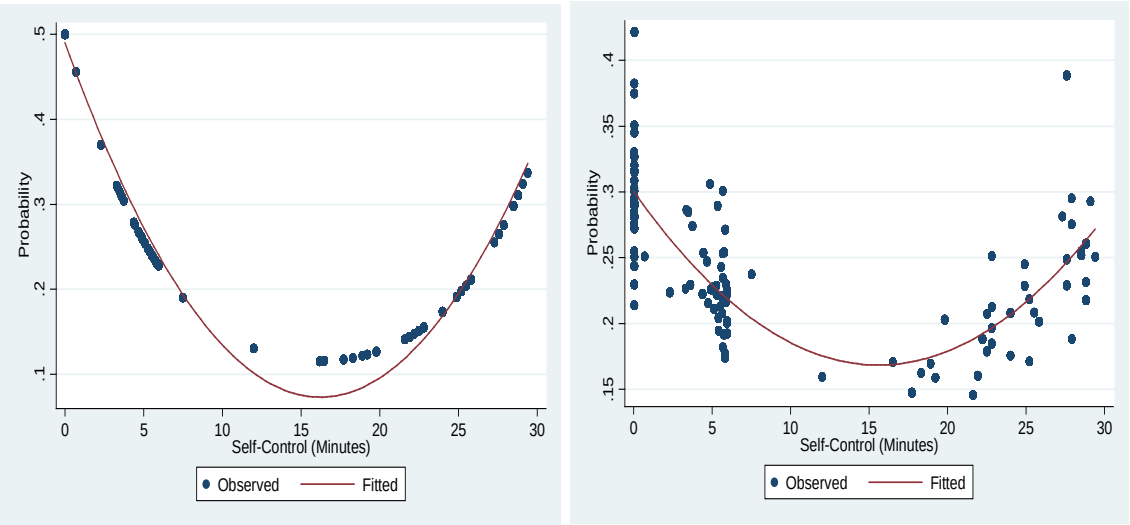

Figure 4. Estimated probability of purchase as a function of self-control time

The Effect of Self-Control on Approach Behavior

The frontal asymmetry index was calculated for each epoch (0.5 seconds prior as baseline correction and 2 seconds post stimulus onset). The results were averaged separately across purchases and non-purchases and are reported for each condition (Baseline, Easy Self-control, and Hard Self-Control) in Figure 5. As we can see, the index values are consistently higher for purchases than non-purchases, which is an intuitive result indicating that subjects display more approach behavior when they are purchasing products. More importantly, the difference in the index value between purchases and non-

purchases is substantially higher in the control compared to the two treatments. In fact, the difference is statistically insignificant for both self-control conditions. This suggests that the approach behavior towards purchases, which was very pronounced in the baseline condition, has disappeared following the 6 and 30 minute videos. The result is quite interesting and is supportive of the knowledge structure model of self-control. The subjects' higher ability to control themselves must have caused them to display less relative approach towards purchases compared to non-purchases, which in turn caused the difference in the frontal asymmetry index to fade. The picture becomes clearer once we analyze the results separately for high-compliers and low-compliers in Figure 6. Although the difference in the frontal asymmetry index between purchases and non-purchases is insignificant for high-compliers in the easy self-control condition, it is highly significant in the hard self-control task. This result is consistent with the previous findings surrounding the interplay between the knowledge structure and resource depletion models. It implies that while compliers in the easy self-control condition are enjoying a higher ability to control themselves since they have accessed the knowledge required to do so, compliers in the hard self-control task become fatigued due to excessive amounts of self-control exertion. Moreover, results for low-compliers in Figure 6 conform to this reasoning. Here, the difference in the frontal asymmetry index between purchases and non-purchases is insignificant in both self-control conditions. This is explained by the fact that the level of self-control exerted by non-compliers in the hard self-control condition was in fact lower than the fatigue threshold, which meant that they were still in the knowledge structure domain and were exercising higher self-control compared to subjects in the baseline condition.

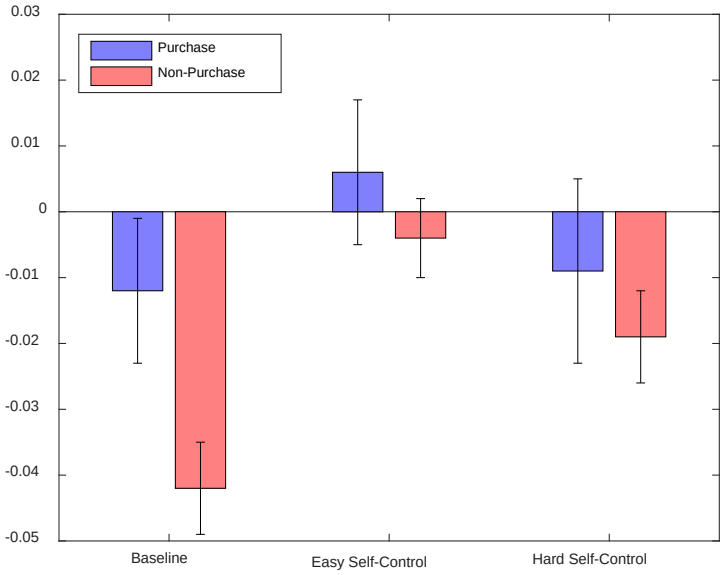

Figure 5. Frontal Asymmetry Index by Treatment and Purchasing Decision

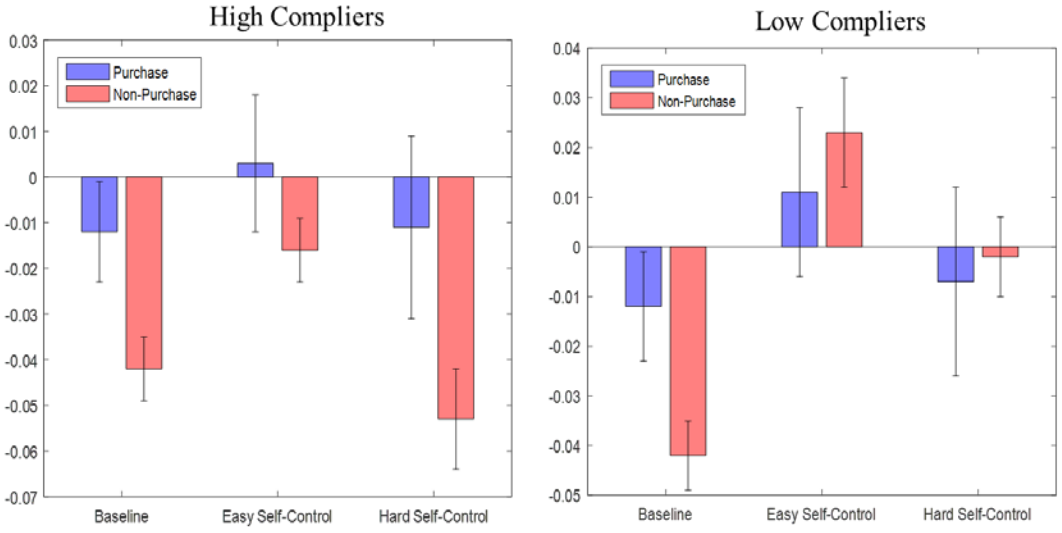

Figure 6. Frontal Asymmetry Index by Treatment and Purchasing Decision by Compliance

Summary

The true effect of self-control on individual decision making has long been a subject of debate in the psychology literature. Three main models, with contradictory predictions, have been presented so far. However, all previous investigations were limited to modeling linear relationships between an initial self-control exertion task and subsequent

self-control ability with assertions of either a positive, neutral, or negative correlation. This study allows for possible non-linear relationships by utilizing biometric tools in a random assignment experiment. This was done in order to provide a better understanding of the underlying forces affecting individuals' self-control levels.

Using eye-tracking data can help us avoid incorrect inference associated with differences in compliance rates with the treatment. That is, although using the overall data shows evidence that solely supports the knowledge structure model, this was an erroneous inference when controlling for the level of compliance with the treatment measured with biometric equipment. By modeling the relationship between self-control time and subsequent purchasing decisions, we find evidence pointing towards the conclusion that the three self-control models are not mutually exclusive and might be operating simultaneously. While the effects of the knowledge structure might be dominant at first, following an initial act of self-control, excessive self-control exertion during this act could drain the subject's resources and lead to fatigue, after which the resource depletion effect becomes dominant. In fact, this result was robust across various specifications of the mode. Moreover, the data shows the fatigue threshold to be around 16 minutes of self-control exertion in the initial task.

Slight gender differences were found regarding the thresholds before which the knowledge structure and the resource depletion are activated. It seems that access to the knowledge required to boost the subject's ability to control himself happens faster for males than females, indicating a lower threshold of knowledge structure for males. However, even self-control exertion for as short as 6 minutes in the initial task resulted in a significant decrease in purchases for both genders. Moreover, the results suggest that,

on average, males can withstand longer periods of self-control than females. This was evident from the fact that female compliers with the hard self-control task exhibited higher signs of resource depletion than male compliers, implying a higher fatigue threshold for males.

Results from frontal asymmetry index provide further support to the finding that the self-control models are in fact operating simultaneously. While subjects in the baseline condition displayed significantly higher approach for purchases compared to non-purchases, the approach behavior was negligible for subjects in the easy self-control condition. This is attributable to the fact that those subjects were enjoying a higher ability to control themselves, which might have decreased their relative approach for purchases compared to non-purchases. Furthermore, compliers in the hard self-control condition exhibited a significant level of approach behavior towards purchases, indicating that resource depletion has impeded their ability to control themselves. On the other hand, the difference in frontal asymmetry index value between purchases and non-purchases was insignificant for the low-compliers in the hard self-control task, which implies that those subjects were still in the knowledge structure domain and below the fatigue threshold.

In conclusion, this article provides strong evidence in favor of a dual impact of self-control on subsequent purchasing decisions. It is possible that the balance between the knowledge structure and resource depletion might play a part providing the individual with the experience required to develop a skill that enhances his ability to control himself. Yet, not much could be ascertained here since this effect could only materialize over long periods of time. One of the limitations of this study, which opens the door for further investigation on the topic, is the fact that it was oriented towards the short term.

This meant that very little can be said about the skill model and how the interplay between the knowledge structure and resource depletion could lead to the development of a skill over the long run that would more permanently change the self-control ability of the individual. Perhaps a field experiment could provide more suitable grounds for further investigation of the mechanism through which the skill model is related to knowledge structure and resource depletion.

Footnotes

1 This self-control task has been widely used and validated in the psychology literature (Baumeister et al. 1998).

2 Self-control is highly correlated to fatigue effects and we are interested in the combined effect since they do not occur separately. Hence subjects in the control condition went directly to the purchasing task.

3 Compliance for fixed thresholds of 80% and 90% were also used to split the subjects into low-compliers and high-compliers. The results were consistent for all thresholds used.

4 The results were consistent across all regression specifications that allowed for a non-linear relationship between self-control time and probability of purchase.

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