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The Short-Term Self-Control Stability of College Students

by

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Submitted in Partial Fulfillment of the Requirements

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## DEDICATION

This is dedicated to my family, Stephen, Susan, Natalie, Andrew, Shawna, and their unborn child. Without their love and support as well as the prayers of Rosary Row I would not have survived this program.

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This study would not have been possible without the help of many people. However, Robert Brame, Tia Andersen, John Burrow, and Michael Turner have helped me in specific ways that have allowed this moment to happen. Tia Andersen was extremely helpful when it came to several aspects of this projects methodology, particularly the qualitative aspects and options for data collection. John Burrow joined very late in the project to fill an absent seat on the committee, agreeing to participate was a daunting task but I am incredibly grateful for his help. Michael Turner provided incredible insight into the theoretical aspects of this study and his contributions will undoubtedly impact every subsequent study regarding these important research questions. Lastly, I want to thank Robert Brame for his incredible guidance and insight. While I never vocalized, I felt there were times this project would never succeed. There were times I felt completely helpless but Dr. Brame would come up with solutions and alternatives that would change my outlook. I have to give a final thank you to CJ Barnes, without his correspondence I feel this project would not be half of what it turned out to be.

ABSTRACT

Since the *stability problem* was first outlined by Gottfredson and Hirschi (1990) in their influential work *A General Theory of Crime* it has received a steady stream of attention from the academic community. Researchers have studied juveniles and adults and have implemented a variety of methodological and statistical approaches. Many of these studies do not show support for the theoretical concept outlined by Gottfredson and Hirschi; yet, there were exceptions. The current study used a slightly different theoretical approach accompanied with research methodology that is still in its infancy. While most studies testing the relative stability of self-control use longitudinal datasets with months or years between waves the current study uses days. The logic behind shortening the wavelength is due to the nature of self-control and its manifestations. If individuals who have low self-control make momentary, snap decisions without thought of the consequences those decisions have the next day, why study low-control over such broad wavelengths? The current study explored the short-term relative stability of self-control. The findings showed strong relative self-control among multiple self-control measures. However, interesting changes were witnessed in absolute stability of self-control.

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# CHAPTER 1

# INTRODUCTION AND PROJECT IMPACT

## INTRODUCTION

Self-control is "the tendency to avoid acts whose long-term costs exceed their momentary advantages" (Hirschi & Gottfredson, 1994:25) and is the sole explanation for deviant behavior (Gottfredson & Hirschi, 1990). Self-control stability has been a topic of concern since the advent of the modern sociological perspective of self-control (Arneklev, Cochran, & Gainey, 1998; Burt, Simons, & Simons, 2004; Na & Paternoster, 2012; Turner &Piquero, 2002). The concept of self-control, and its position on stability, posits a unique hypothesis which does not agree with other contemporary sociological theories of crime (Gottfredson & Hirschi, 1990). The stability hypothesis suggested by Gottfredson and Hirschi (1990), assumes that the determinant of crime, self-control, is not situational and therefore is not influenced by other sociological variables. Therefore, any variables other than self-control that are associated with crime are spurious. Gottfredson and Hirschi adamantly state that self-control is not a trait; however, other researchers disagree (Burt, 2014). Research conducted on absolute and relative stability of self-control has been conducted in the past (Arneklev et al., 1998; Burt, Simons, & Simons, 2004; Na & Paternoster, 2012; Turner &Piquero, 2002); however, continued exploration is necessary.

This dissertation added to the existing self-control stability literature. The current study took past work in the area of self-control and its stability into consideration when constructing measures for the variables, survey instruments, research design, and choosing the most effective and appropriate analytic strategy. However, the current study was not limited or strictly confined to these past tests and utilized innovative tools not commonly found in the field of criminology.

The general theory of crime is a unique concept in criminology and the future of criminological thought can be improved through the repeated testing of the theory's hypotheses. Self-control remains one of the most robust predictors of crime and deviant behavior (Pratt & Cullen, 2000). Specifically, the continued study of the stability hypothesis allows researchers to understand how, why, and when people commit criminal offenses over the life course.

## PROJECT IMPACT

This research is extremely important to the field of sociology and more specifically criminology and criminal justice because it is potentially transformative. The current study created new questions about how self-control is acquired and its manifestations due to the patterned fluctuations observed over time. Self-control theory has deep roots in a variety of disciplines including sociology, criminology, psychology, and economics. The current research addressed a hypothesis proposed by Gottfredson and Hirschi (1990), that self-control is relatively stable over time. Several criminologists have tried to answer this question using long wavelengths (Burt et al., 2004; Na & Paternoster, 2012; Turner & Piquero, 2000). Addressing self-control stability from a

short-term perspective provided greater understanding of self-control and will impact further academic research leading to more informed policy implications.

Gottfredson and Hirschi (1990) state that self-control increases due to the natural aging of the organism but fail to clarify how this occurs. The current study showed self-control increasing and decreasing predictably throughout the week. However, the sample, on average, appeared to gradually increase their level of self-control affirming the proposition that self-control increases over time. Because the current study showed a great amount of relative stability it seems like it would be more effective to target time periods where self-control is likely to drop as opposed to a specific at-risk population.

The study of short-term stability of self-control has several benefits. First, individuals with low self-control live in the moment and have little consideration for the future consequences of their actions. Studying self-control stability in the short-term allows for the better understanding of how self-control changes over time. Second, Burt, Sweeten, and Simons (2014) have shown that self-control is unstable over a period of years with some people increasing their level of self-control, decreasing, and even staying the same over time. Studying this variability may shed light on how people offend at different times or moments in their life due to increasing or decreasing levels of self-control. For instance, individuals who exercise self-control may eventually engage in risky, impulsive, or self-centered behavior, among others. These individuals may continue to engage in these behaviors because of a sense of apathy towards using self-control in the future (Polivy, Herman, Hackett, & Kuleshnyk, 1986). Theoretically this would support the idea that self-control stability is subject to the concept of state dependence, the idea that future events are influenced by the past, instead of population

heterogeneity, where variation occurs because of the differences within individuals; which was an assumption of Gottfredson and Hirschi. Lastly, the stability hypothesis is a major theoretical proposition made by Gottfredson and Hirschi (1990). Exhaustive study of stability is important to determining whether Gottfredson and Hirschi's (1990) hypothesis is supported.

Gottfredson and Hirschi seemed to be rather pessimistic about policy and self-control improvement. This is due to the nature of self-control being stable over time and requirements to engage in crime. The requirements necessary for the commission of any crime is the obvious opportunity and low self-control. Because of the stability postulate proposed by Gottfredson and Hirschi, only policies such as selective incapacitation or socialization prior to 8 years of age can prevent lapses in self-control and criminal behavior. On the other hand, self-control can change, the opportunity to develop policies that improve self-control become possible (Burt et al., 2004; Na & Paternoster, 2012; Turner & Piquero, 2002).

Much can be learned from the psychological literature on the dynamic nature of self-control. Psychological studies have shown that self-control can change from moment to moment (Baumeister, 2002; Muraven, Pogarsky, & Shmueli, 2006; Muraven, Tice, & Baumeister, 1998). The prominent self-control theories in psychology rely on the concept of state dependence, in which future levels and ability to exercise self-control are affected by past events where self-control was required. Much evidence has shown support for state dependence models like the strength model as opposed to psychological models like the skill model which is more akin to population heterogeneity in which successive trials using self-control are not effected by past events (Baumeister, 1998;

Muraven et al., 1998). Because of the success seen in the psychological literature regarding self-control stability there may be a similarity in the Gottfredson and Hirschi concept of self-control. Although the state dependence approach is not congruent with the theory proposed by Gottfredson and Hirschi, the manifestations of low self-control may decrease in frequency, magnitude, or qualitatively change due to past events. Simply put, the commission of crime is not stable in the short-term. Crime rates predictably spike and decrease at specific times of day, day of the week, and months of the year. Understanding how and why self-control fluctuates within and between individuals is essential to understanding why crime rates fluctuate.

# CHAPTER 2

# THEORETICAL BACKGROUND

## THE ORIGINS OF SELF-CONTROL THEORY

Some theories of crime, like most derivations of Merton's (1938) strain theory, are based on the assumption that human beings are naturally cooperative, altruistic, and for a lack of a better term, good. Control theories, including self-control theory, do not share this assumption, and instead subscribe to the idea of criminal behavior as a chosen pathway. Classical theory assumes that people are naturally hedonistic. Self-control theory is rooted in Beccaria's assumption of free will and Bentham's concept that people seek to maximize pleasure and minimize pain (Gottfredson &Hirschi, 1990). Gottfredson and Hirschi (1990) state the utility principle (the idea that people try to maximize pleasure and minimize pain) outright at the beginning of their book, and even go as far to say; everyone wants "money without work, sex without courtship, revenge without court delays." The rational nature of classical theory is essential for self-control theory. People must weigh the benefits and consequences of actions every day, and those who cannot resist the urge to "act" despite the consequences, naturally have low self-control. The classical concept of criminal behavior does not include the idea of "individual restraints" which may lead a person to or from crime (Keane, Maxim, & Teevan, 1993), an issue addressed by control theorists.

Jeremy Bentham (1879) outlines four consequences of criminal activity, which include, legal/political, social, religious, and physical. Gottfredson and Hirschi subscribe

to these punishments or consequences, but in different ways. The most obvious being the legal/political sanctions that comes with the commission of a crime, such as, incarceration, fines, and a criminal record. However, Gottfredson and Hirschi also posit the concept of analogous behaviors. While these behaviors are not criminal by nature or may be criminal in some jurisdictions and not others they still come with social or physical costs. Additionally, Gottfredson and Hirschi (1990) suggest that individuals possessing low self-control are more prone to accidents, which furthers the idea that criminality (a concept synonymous with self-control (Burt, 2014)) has physical consequences.

It is important to recognize the classical roots of self-control before the theory is analyzed from a control theory perspective because it gives context to the theory. First, self-control is studied from an individual level, not a macro level like other sociological theories[1]. Second, self-control theory is based on the concept of rational thought. Because self-control is based on the idea of rational thought, Gottfredson and Hirschi (1990) discount other influences of social or biological process, stating that any other correlations between theoretical constructs and crime are spurious. While opportunity can be seen as a social process and is necessary component for crime, Gottfredson and Hirschi (1990) articulate that opportunity is created by individuals possessing low self-control.

[1] By the end of the 19th century and continuing through the 20th century a number of macro level theories that study crime on an aggregate level became popular. Some of these macro levels theories or various social structure theories include strain theory developed by Merton (1938), social disorganization theory (Shaw & McKay, 1942), and the development of cultural theory (Ferracuti & Wolfgang, 1967).

**From Past Control Theories to Self-control**

Emile Durkheim developed some of the main components of control theories before modern control theories emerged in the 20th century. In Durkheim's text, Moral Education (2012), he established the idea that morality is instilled in the child by the parents early in the child's life but as the child enters the "second period of childhood" schools assume the role of morality development. One of the most important elements to Durkheim's philosophies in Moral Education is the role of punishment by the parents and the school in the development of morality (Durkheim, 2012). The role of punishment would later become an integral component in the development of self-control in Gottfredson and Hirschi's (1990) self-control theory.

One of the first modern appearances of control theory was in 1951 when Albert Reiss published *Delinquency as the Failure of Personal and Social Controls*. Reiss' definition of personal control reflects the concepts self-control designed by Gottfredson and Hirschi almost 40 years later. According to Reiss (1951), delinquency occurs because of the failure to effectively exercise personal control to conform to the norms of a social system. Reiss makes no claim to particular kinds of crimes or delinquency that are violated because of relatively weak personal control (Reiss, 1951), a claim adopted by Gottfredson and Hirschi when constructing their theory of self-control.

An additional aspect of Reiss' control theory that Gottfredson and Hirschi adopt is the acquisition of personal control. This acquisition section of the theory is important because, once again, it is almost identical to self-control theory. First, the focus is on children. While Reiss does not create a firm date of self-control acquisition like

Gottfredson and Hirschi (8 years old) they do stress the idea that personal control is developed when the individual is young. Second, Reiss states that the "dissemination of norms and rules" is primarily instilled by the parents[2]. It is the primary responsibility of the parents to make their children aware of what social controls are to be observed, such as, it is against the law to steal, as well as, how to behave (personal control). The primary method for instilling these boundaries and behavior is through proper discipline of the child. However, it is important to note that "proper" discipline must be just, and cannot be too harsh or too lax (Reiss, 1951). This concept was later expanded by Nye (1958) to reflect too much control (complete control) over the child and not enough control (complete freedom) over the child.

When Nye (1958) published his work, he too focused on conformity of individuals as opposed to nonconformity and set out to explain why individuals do not commit more criminal acts. Using this concept, the focus of researchers should not be on finding some "positive" correlate of crime, such as, biology, psychological trait, or social condition, but on social control. By finding the factors that control society and identifying the controls that are not functioning properly the opportunity to commit criminal acts would emerge.

Much like Reiss (1951), Nye's focus was primarily on juveniles and the influence of the family on their children. According to Nye (1958), there were four modes of social control that were most effective when applied by the parents. The four modes created by

[2] In Reiss' original 1951 study, he notes that higher recidivism rates occur among children who are placed in foster care or are institutionalized. While the higher recidivism rates may be a function of past parental interaction with the child, it may also be due to selection bias.

Nye were direct control, internalized control, indirect control, and control through alternative means of need satisfaction. While these modes appear to be independent of one another, Nye insists that they are all mutually reinforcing and apply equally to the overarching construct of social control. Direct control was illustrated in the form of punishment by authority figures when norms are violated. These figures of authority could include teachers and police officers, as well as parents, who were thought of as the most effective at exercising direct control. Internalized control is equivalent to Reiss' personal control and Gottfredson and Hirschi's self-control.

In addition to Reiss and Nye's work in control theory, Walter Reckless (1967) developed his own concepts of control. His theory of containment contains several factors including outer containment, inner containment, and a description of "pushes and pulls" that lead individuals to commit crime. While all of these factors merit the consideration of control researchers when analyzing crime, the concept of inner containment and its components correspond closely to Gottfredson and Hirschi's self-control theory; interestingly enough, inner containment was also a primary focus of Reckless' theory.

While there are four components that comprise the concept of *inner containment* the most important component, as it applies to self-control theory, is *frustration tolerance*. Reckless (1967) suggested that individuals who exhibit low frustration tolerance to ordinary failures and upsets of life are less likely to cope with them in a constructive manner. At the onset, frustration tolerance seems more akin to general strain theory than self-control theory. However, Reckless (1967) argues that the inability to exert self-control may be the result of low frustration tolerance. It is important to note,

considering the causal order of self-control and low frustration tolerance. Reckless argues that insufficient self-control to cope with failure and disappointment is the definition of low frustration tolerance. Statements made by Reckless regarding the definition of frustration tolerance, how it affects the individual, and the manifestation of low self-control could be the first evidence of tautology regarding the theory. While it is not pertinent to the success or failure of containment theory this tautology is an interesting concept that predates the criticisms made by Akers (1991) about Gottfredson and Hirschi's version of self-control theory[3]

Hirschi's own theoretical transformation from social bond theory to self-control theory is interesting. Self-control is essentially the individual's propensity to offend; because this is the primary mechanism for the commission of crime everything else is irrelevant (Burt, 2014). To better illustrate this dramatic leap from Hirschi's social bond theory (1969), and control theory in general, it is important to understand the basic elements that make up social bond theory.

Hirschi (1969) outlines four elements that comprise social bond theory. While there are four elements, these elements or bonds can work concurrently to form a stronger

[3] It is important to note that the two tautologies mentioned, the first stated here regarding Reckless' (1967) theory and the second regarding Akers (1991) argument, are in different contexts. The first tautology referenced in Reckless' work is observed in the context of self-control creation. Reckless used self-control in his definition of *frustration tolerance* arguing that using self-control to acquire a higher degree of frustration tolerance subsequently creates variant levels of self-control. This may be an oversight in the theory's construction; nonetheless, the loop system of causal order creates substantial problems theoretically, logically, and statistically during analysis (Davis, 1985). The second tautology in Gottfredson and Hirschi's theory was argued by Akers (1991) and was derived from a methodological perspective, which is primarily concerned with the operationalization and measurement of self-control in the context of crime.

individual who is more resilient to criminal opportunity. The first element of social bond theory is attachment. This form of indirect control manifests itself in the form of emotional closeness to others. Individuals who care about their parents' opinions, and feel the negative consequences of their poor behavior via parental disappointment will be more likely to refrain from engaging in crime.

A second type of social bond is commitment. Commitment to conventional values such as education, and occupational aspirations make the loss of these values, as a consequence of crime, too great. This is the classic concept of stakes in conformity. Riess (1951) even defines delinquency as "… the behavior consequent to the failure of personal and social controls to produce behavior in *conformity* [emphasis added] with the norms of the social system to which legal penalties are attached." (Riess, 1951:196).

The third type of social bond is involvement. The concept of involvement directly ties to opportunity aspects of routine activities theory. Although Cohen and Felson (1979) published their routine activities theory after Hirschi's social bond theory (1969), the premise of having the opportunities to commit crimes, whether the motivation is there or not, precedes both theories (Cohen, 1959). Hirschi illustrates opportunity in a different way, stating that the participation in conventional, socially acceptable activities occupy the time of would be offenders, which would prevent them from committing crime simply because they cannot do two things at the same time.

The final social bond that Hirschi described is the concept of belief. The belief element assumes that individuals who accept that the rules of society, such as criminal laws, civil laws, policies of organizations, will not commit criminal acts. This form of belief is more intrinsic than Sykes and Matza's (1957) and in a certain way completely

different. Hirschi made it clear that although individuals "believe" in the rule of law, in other words recognize their existence, this does not equate to personally feeling the rule of law is a valid regulation.

Elements of self-control theory can be seen in many social control theories of the past. Gottfredson and Hirschi's (1990) self-control theory is an internal control theory with limited social influence after the age of 8. Taking this into consideration there has been little attempt, with limited exceptions (Laub, 2002; Gottfredson, 2006), to link these theories together. As detailed above, there are aspects of Riess (1951), Nye (1958), and Reckless' (1967) theories that bear striking resemblance to self-control theory.

Travis Hirschi made it evident in both social control, as well as self-control, that individuals are restrained from acting on impulses because of the controls in the individual's life. The major difference between the theories is the source of that control. The onset of each theory is sociological (a social process is necessary to instill or bonds or self-control) which is why Gottfredson and Hirschi's theory is a sociological theory of crime. Self-control theory posits that the creation of self-control comes from effective parenting at a young age. In Hirschi's previous work (1969), the development of controls can occur at any age and by various means.

The one critical point of deviation from social bond theory and self-control theory is the idea that social bonds no longer influence impulses when self-control, if it is well measured, is taken into consideration. In other words, the relationship between social bonds and crime is spurious. Each social bond can logically be explained away using self-control. Social bond theory suggests that children who are attached to their parents (the social bond of attachment) are less likely to commit crimes. However, children who

have low self-control have difficultly forming attachments, and are therefore, more likely to commit crime. Each social bond-to-crime argument can be made spurious through this reasoning.

The only social bond that is kept (but only in part) is the concept of involvement. Gottfredson and Hirschi (1990) suggest that opportunity is necessary and is a function of self-control. Individuals who are low in self-control are more likely to enter situations in which the opportunity for crime exists. In other words, people with low self-control create their own opportunities for crime. Considering these arguments, Gottfredson and Hirschi believe that social bonds are simply the indicators of an individual's level of self-control and therefore have no independent effect on crime.

Over the years, Hirschi identified a correlate of criminal activity that has yet to be effectively challenged, time (Hirschi, 1983). The age-crime curve is one of the most stable patterns of criminal activity. The life-course line of research has become a prominent area of study in modern criminology (Sampson & Laub, 2016); however, no one has been able to identify a variable, or set of variables that explains crime over time better than time itself (Hirschi, 1983). Hirschi (1983) explains that even the search for variables to explain crime is futile because researchers are simply identifying correlates of age. This robust predictor of crime is also incredibly stable which starts to lay the foundation for self-control theory. Age even plays a key role in explaining why self-control continues to increase over time (Gottfredson & Hirschi, 1990).

## SELF-CONTROL: A GENERAL THEORY OF CRIME

Gottfredson and Hirschi's theory has changed overtime, sometimes by the authors themselves (Hirschi, 2004; Hirschi & Gottfredson, 1993). Although the concept of self-control has remained relatively constant, the operationalization, among other aspects of the theory, has changed. Most of the original concerns revolved around measurement, proper causal order, and tautology (Grasmick et al., 1993; Keane et al., 1993; Akers, 1991). Over time, Gottfredson and Hirschi began to accept the progress and alternative conceptualizations made by psychology as valid alterations to the original theory (Hay & Meldrum, 2015). Although the consequences of self-control remain the same, progress continues to occur concerning the development of self-control, primarily what comprises self-control and the impact each element of self-control independently has on crime. However, there are some aspects of self-control theory that remain unchanged, even in light of new evidence. Therefore, in order for self-control theory to remain influential in the field of criminology it will have to evolve, incorporating new concepts and ideas (Burt, 2014).

Gottfredson and Hirschi (1990:95) describe self-control as "factors affecting the calculation of consequences of one's acts". Gottfredson and Hirschi (1990) lay the foundation for the components of self-control in their section titled "The Elements of Self-Control" (p. 89). They later clarify this by saying self-control is "the tendency to avoid acts whose long-term costs exceed their momentary advantages" (Hirschi & Gottfredson, 1994:25). Individuals low in self-control prefer to have their needs met in a short timeframe and cannot deter gratification. They also tend to lack persistence and/or diligence in tasks. This is evident in the correlation found between academic

performance/cheating and self-control levels (Cochran, Wood, Sellers, Wilkerson, Chamlin, 1998). Gottfredson and Hirschi (1990) state people lacking self-control tend to be more adventuresome, engage in risky behavior, and are more physically active. They also tend to have difficulty maintaining jobs and have unstable marriages or relationships. In addition to poor work habits, people with low self-control often do not possess the cognitive skills necessary for career advancement and many devalue or are not concerned with academic achievement; this concept parallels Hirschi's (1969) previous ideas of commitment. Individuals with low self-control are also self-centered and are not empathetic to people they harm and are apathetic in general (Gottfredson & Hirschi, 1990). This element of self-control is the most reminiscent to Hirschi's social bond of attachment (Hirschi, 1969). Although Hirschi (1969) primarily associates attachment with the parents of the delinquent, attachments can be made with anyone. However, self-centered individuals will probably have difficulty forming an attachment to someone else (Gottfredson & Hirschi, 1990).

Gottfredson and Hirschi (1990) argue that variation in self-control is the primary explanation for all forms of criminal conduct. Gottfredson and Hirschi (1990) believe that theories that explain specific criminal behaviors, such as serious crimes, are fundamentally flawed. Assuming the seriousness of an offense as a theoretical criterion is incorrect and carries with it no theoretical justification. However, limits can be placed on the explanatory power of a theory, but it is the task of the researcher to provide evidence that the theory will not explain behavior past a theoretical threshold (Gottfredson & Hirschi, 1990). Gottfredson and Hirschi (1990) assume the simplicity and versatility of the theory make the testing of a general theory of crime easy and the

results would provide evidence that the theory explains crime across gender, cultures, and occupations.

The versatility of criminal behavior, or the variety of crime individuals choose to commit, is a postulate rarely held in traditional theories of crime. However, much research has shown that criminals show a wide variety and diversity in the in which they choose to engage. The concept of versatility holds true across different demographics such as, gender (Mazerolle, Brame, Paternoster, Piquero, & Dean, 2000), or types of offenders like white collar and street offenders (Benson & Moore, 1992). The versatility assumption held by Gottfredson and Hirschi (1990) is crucial for the broad scope of the theory, and is supported by the fact that criminals commit a wide variety of criminal offenses. While criminals tend to specialize for short periods during their criminal careers they tend to revert back to a more versatile repertoire not long after specialization begins (McGloin, Sullivan, Piquero, & Pratt, 2007). While the short stint of specialization is interesting, it also supports Gottfredson and Hirschi's assumption that criminals are versatile and are quite stable in their versatility throughout their life course.

Gottfredson and Hirschi (1990) suggest that crime is a function of low self-control and opportunity; however, researchers tend to view this statement in a way that is other than intended (LaGrange & Silverman, 1999). Gottfredson and Hirschi clearly state that while opportunity is necessary for committing crime, the threshold required to satisfy what Gottfredson and Hirschi (1990) consider opportunity is actually quite low. Individuals who have low self-control tend to make their own opportunities to commit crime, not simply wait for opportunities to present themselves. Studies testing Gottfredson and Hirschi's (1990) concept of self-control tend to put too much stock in the

concept of opportunity, almost to the point where the lack of opportunity would eliminate crime (LaGrange & Silverman, 1999; Longshore & Turner, 1998). However, Gottfredson and Hirschi seem to be correct in that self-control is still a predictor of criminal offending whether opportunity, as it has been measured and tested by others, is present or not (Hay & Forrest, 2008).

**Measuring Self-Control**

Grasmick et al. (1993) identify six components of self-control as their way of measuring Gottfredson and Hirschi's elements of self-control. The self-control scale constructed by Grasmick et al. (1993) consisted of 24 different items, four for each of the six components. The final six components measured *impulsivity, simple tasks, risk seeking, physical activities, self-centeredness,* and *temper*. Each of these elements identify the degree to which people delay gratification and control their actions. The items used to determine the level of self-control were attitudinal in nature. The use of attitudinal verses behavioral measures would become part of a debate in future articles. Gottfredson and Hirschi (1990) believe that behavioral measurements were the most appropriate for determining levels of self-control.

Keane et al. (1993), on the other hand, used behavioral measures to determine self-control. The measures used by Keane et al. (1993) consisted of both self-reported measures like whether or not the subject was wearing a seatbelt, as well as, the recorded levels of blood alcohol concentration while the individual was drinking and driving. Additionally, the Keane et al. (1993) measures can be considered measures of analogous behaviors. The Keane et al. (1993) study demonstrates a unique, albeit incomplete,

measurement of self-control. The measures used do not fully encapsulate the concept of self-control, and rely on measures that appear tautological (Akers, 1991; Keane et al., 1993)[4]. These first papers on Gottfredson and Hirschi's (1990) version of self-control started a theoretical discussion primarily concerned with resolution of whether behavioral measures are better than attitudinal measures, as well as discussions of the tautological problem raised by Akers (1991).

The manner in which self-control has been measured has varied greatly. In addition to the behavioral/analogous measurements of self-control used by Keane et al. (1993), there have been direct behavioral markers, as discussed by Wilson and Herrnstein (1985) in which subjects had to refrain from drawing outside the lines of a maze. Behavioral measures that are not reported by the subject would suggest a more valid measure. This is due to the subjects' lack of honesty when completing a survey instrument (Gottfredson and Hirschi, 1990). Self-control differences between groups have been shown to affect the performance of a survey instruments, particularly the Grasmick et al. (1993) scale, garnering evidence to support Gottfredson and Hirschi's (1990) assumption (Piquero, MacIntosh, & Hickman, 2000). Wright, Caspi, Moffitt, and Silva (1999) determined self-control by observations made by teachers and parents.

In addition to the several behavioral measures used in sociological studies, the field of psychology has used some interesting direct measures of self-control. Some of

[4] One measure of self-control asked respondents whether they thought they were over the legal limit to drive as a way to gauge impulsivity. Since drinking and driving is against the law using this to predict crime can be seen as a weak measure of impulsivity and tautological. Keane et al., (1993) recognize these imperfections and list it as a limitation of using secondary data.

these direct measures were used by Muraven, Tice, and Baumeister (1998) and include metrics like, how long someone can squeeze a hand grip, refraining from laughing at something funny, abstaining from the thought of white bears. For instance, subjects were asked to not think of a white bear. Subjects then tried to think of other mental images but if they thought of a white bear it was seen as a lapse in self-control. However, the Grasmick 24 item scale still remains the most common measure of self-control (Tittle, Ward, & Grasmick, 2003; Marcus, 2004), at least in the field of criminology.

While this certainly demonstrates the diversity of measurements used to capture the concept of self-control, the issue of superiority between behavioral and attitudinal measures, and tautology, to this point, have yet to be fully resolved. Despite Gottfredson and Hirschi's (1990) argument about measurement preference, Tittle et al. (2003) have shown that cognitive/attitudinal measures perform just as well empirically at predicting deviance as behavioral measures. More evidence to support the equality between behavioral and attitudinal measures has also been found in a meta-analysis conducted by Pratt and Cullen (2000). Additionally, Gottfredson and Hirschi (1990) assume that all analogous behaviors to crime are created equal. In other words, it does not matter which analogous behaviors are used in the study because they are all interrelated. This assumption of equality did not find empirical support (Tittle et al., 2003), which may bolster arguments of tautology (Akers, 1991).

Akers (1991) said it would be inappropriate to use self-control to explain the propensity to commit crime because self-control is stated as being equal to the propensity to commit crime. Additionally, Akers (1991) points out that Gottfredson and Hirschi (1990) offer no definition of self-control. Gottfredson and Hirschi (1990) simply state a

number of characteristics of someone who has low or high self-control. Because of this lack of definition, Akers (1991) argues that it is impossible to determine if someone has low self-control unless a crime or analogous behavior is committed. If this is true then the general theory of crime is indeed tautological.

While Hirschi and Gottfredson (1993) suggest that Akers' (1991) definition of self-control differs fundamentally from their own, they do realize the problem they created by not operationalizing their own concept. Therefore, Hirschi and Gottfredson (1993) gave a number of analogous behaviors in line with the wishes of Akers (1991. These independent measures of crime are, but not limited to, whining, pushing, shoving, smoking, and drinking (Hirschi & Gottfredson, (1993).

Despite Gottfredson and Hirschi's concession that indicators of self-control could be specified more fully, some theorists believe this is easier said than done. Marcus (2004) argues that previous research on self-control is misguided. In fact, the elements that comprised self-control do not exist at all and fail to be unidimensional, based on aspects of those elements. This conclusion was reached because the elements of self-control seem to scatter when applied to the 'five-factor model', which is a psychological metric of personality[5]. The 'five-factor model' is generalizable across cultures, but there are mixed results when the Grasmick et al. (1993) scale was tested. Additionally, Marcus (2004) posited that self-control is a trait of differential control and not of motivation, a belief contrary to Burt and Simons (2013), and that self-control is manifested in behavior, as opposed to self-reflection or evaluation. Motivation is not a factor in Gottfredson and

[5] For further explanation on the 'five-factor model' and its development see Digman, (1990).

Hirschi's (1990) original formulation of the theory because motivation is an obvious and critical element of crime. The more intriguing question Gottfredson and Hirschi (1990), as well as other control theorists try to answer, is why do people resist involvement in acts that are universally viewed as attractive or expeditious solutions to their problems.

In summation, measures of self-control have either suffered from a lack of theoretical consistency or fall short of being psychometrically sound. Behavioral measures tend to be more consistent with the theory; however, they fail to meet acceptable measures of psychometrics. One the other hand, attitudinal measures tend to be more psychometrically sound, yet tend to be more inconsistent with the theory, an issue addressed by Hirschi and Gottfredson (1993). An alternative scale designed by Marcus (2003), which tries to account for the deficits in previous scales yielded effect sizes much higher than past analyses[6]. Additional analyses could dramatically impact the way self-control theory fits into criminological research. The current study addressed this by using both attitudinal and behavioral measures of self-control.

**The Empirical Standing of Self-Control**

*A General Theory of Crime,* has been cited over 8,000 times making it one of the most influential criminological texts. Gottfredson and Hirschi's (1990) version of self-control has been used to account for differences in criminal behaviors between groups

[6] The Retrospective Behavioral Scale (RBS) was tested in a study measuring the correlation between self-control and deviance in the workplace. The study produced and effect size of $r = .63$, which far exceeds Pratt and Cullen's (2000) estimates for both behavioral (r = .40) and attitudinal (.32) measures (Marcus, Schuler, Quell, & Hümpfner, 2002).

including gender (Burton, Cullen, Evans, Alarid, Dunaway, 1998), as well as, age and race (Arneklev, Grasmick, Tittle, & Bursik (1993). Past research indicates that parenting has a significant effect on the development of self-control (Hay, 2001; Pratt et al., 2004). Additionally, Longshore (1998) provided evidence to support the concept proposed by Gottfredson and Hirschi (1990) that crime is a function of low self-control and opportunity. There is much evidence in support of the general theory of crime; however, there is some concern over various theoretical assumptions and measurement issues. These issues should be addressed in order to validate the vast amount of research supporting the theory.

The process by which self-control is tested has evolved over the years. This evolution started with Grasmick et al. (1993) and Keane et al. (1993) who were the first to test Gottfredson and Hirschi's (1990) theoretical assumptions. While both of these studies were groundbreaking in the testing of self-control theory their contributions set off a conflict between the proponents of the different measurement methods that would last for years. Grasmisck et al. (1993) used an attitudinal or cognitive scale that assessed the six elements that comprise self-control which were described by Gottfredson and Hirschi (1990), while Keane et al. (1993) used behavioral measures to test the overarching concept of self-control. However, this did not stop others from developing alternative self-control scales (Marcus, 2003).

Akers (1991) claimed that the behavioral measurements of self-control were tautological. Gottfredson and Hirschi's response to the initial tests and critique of their theory was rather well received (Hirschi & Gottfredson, 1993). Hirschi and Gottfredson (1993) took the tautology comment from Akers (1991) as a compliment but conceded

that tautology could and should be avoided. Hirschi and Gottfredson (1993) stated that non-criminal measures of self-control (if behavioral measures are chosen) should be used to avoid tautology. Additionally, serious delinquents underreport their own delinquent behavior (Hindelang, Hirschi, & Weis, 1981); therefore, refraining from using self-reported surveys would increase the validity of the studies (Gottfredson & Hirschi, 1990).

The arguments of tautology and the behavioral vs. attitudinal measures debate have all but disappeared due to subsequent studies and commentaries tackling the issue (Hirschi & Gottfredson, 1993; Marcus, 2003, 2004; Piquero et al., 2000; Tittle et al., 2003). However, there are several issues concerning the measurement of self-control in studies that concern researchers. These issues have yet to be resolved and until they are rectified an appropriate test of self-control cannot be accomplished.

The factor structure of self-control scales is one such issue that has yet to be resolved. The first study to test the unidimensionality of self-control found that self-control was not unidimensional as proposed by Gottfredson and Hirschi (1990) (Longshore, Turner, & Stein, 1996). Longshore et al. (1996) also found that the multifactor subscale was not tenable among women. The factor analysis showed a three-factor model best fit women offending while a five-factor model best fit male offending. This violates the theoretical assumptions proposed by Gottfredson and Hirschi. Reanalysis of the data using modified statistical techniques ensured that the Grasmick et al. (1993) scale was unidimensional and equally predictive across gender (Piquero & Rosay, 1998). Longshore, Stein, and Turner (1998) disagreed with some of the statistical techniques, their subsequent results, and opted for the support of Longshore et al. (1996) original conclusion.

One of the most current articles (Burt et al. 2014) uses the group-based trajectory model to map groups of similar developmental patterns. Group-based trajectory is used to identify the heterogeneity between groups of offenders that make up a sample population. The Burt et al. (2014) study, found self-control to be multidimensional, which contradicts Gottfredson and Hirschi's (1990) hypothesis. Therefore, Burt et al. (2014) used a group-based trajectory model for self-control, as well as, each of the individual dimensions found. These separate dimensions include *impulsivity* and *risk taking*. The fact that Burt et al. (2014) found multidimensionality in self-control is not all that surprising due to past studies coming to the same conclusion (Cochran et al., 1998[7]; Piquero & Rosay, 1998; Wood, Pfefferbaum, & Arneklev, 1993). Past studies on risk taking, particularly those with juvenile samples, found *risk taking* to be an important predictor of deviant behavior (Gardner & Steinberg, 2005; Romer et al., 2009; Steinberg, 2004, 2005).

Researchers have also tested the theory's 'group invariance' postulate in conjunction with dimensionality. Gottfredson and Hirschi (1990) suggest that self-control is invariant across cultures and demographics. A study analyzing three different European countries, along with the United States, found self-control to be equally predictive between different cultures (Vazsonyi, Pickering, Junger, & Hessing, 2001). In subsequent studies, self-control was also able to strongly predict deviance in eastern

[7] Cochran et al. (1998) found some evidence to support the multidimensionality of self-control. Using the Goodness of Fit Index high loading (on first order factors but not on second order, which is self-control) were found on *Impulsivity* but a relatively weak loading on *risk taking*.

counties, such as Japan (Vazsonyi, Wittekind, Belliston, & VanLoh, 2004). While both of these studies provide evidence to support the claim that self-control is cross-cultural they also show that self-control is multidimensional instead of the unidimensional concept posited by Gottfredson and Hirschi (1990)[8]. Follow-up studies addressing the more culturally specific aspects of family processes (Vazsonyi & Belliston, 2007) and even different economic strata (Vazsonyi & Klanjšek, 2008) support the 'group invariance' postulate.

While there is evidence to support both sides of the dimensionality argument it still seems to be unresolved (Piquero & Goode, 2008). However, advancements of neurobiology and their integration into criminological literature may put the dimensionality argument to rest. The brain develops at different rates among adolescents, consequently, the regions of the brain responsible for impulsivity and sensation seeking (two elements of self-control) develop at different times (Casey, Getz, & Galvan, 2008; Steinberg, 2008). Using this rationale, Burt et al. (2014) found evidence to support the hypothesis that these dimensions are independent and therefore determining that self-control is multidimensional. However, in sum, the majority of the criminological research of the subject of dimensionality is mixed, therefore, leading to hesitance in claiming whether the concept is multidimensional or not (Burt et al, 2014).

[8] Both of these studies used the Grasmick et al. (1993) scale to measure self-control. This gives consistency to the previous studies and a way to fairly compare them. While Vazsonyi et al. (2001, 2004) show that the Grasmick et al. (1993) scale is a valid and reliable predictor of deviance; their evidence does not show support for Piquero and Rosay's (1998) claims of unidimensionality.

A final point of contention is the use of self-reported measures of self-control. As previously stated, delinquents (individuals with low self-control) are more likely to be deceptive on self-reported surveys (Gottfredson & Hirschi, 1990; Hindelang et al., 1981; Hirschi & Gottfredson, 1993). Delinquents tend to over report socially desirable behaviors (Hadaway, Marler, Chaves, 1993) and tend to under report socially undesirable behaviors. While individuals may intend to lie on survey responses they may also view themselves in a less-than truthful way, therefore, engaging in self-deception (MacDonald, Morral, & Piquero, 2011). Adding measures of social desirability to a survey can help account for this issue of validity.

Socially desirable response bias is a tendency to answer questions in a manner that conveys a favorable impression of the individual answering the question (Paulus, 1991). Using factor analysis and granting anonymity to respondents can mitigate a socially desirable response bias; however, the use of a socially desirable response scale can be used as a statistical control when analyzing criminological data. The first study to use a socially desirable response scale in the context of self-control and crime was MacDonald et al. (2011). Past studies have used social desirability to explain differential self-control responses but these studies were conducted in different disciplines, such as economics (Ameriks, Caplin, Leahy, Tyler, 2004). Through the use of the socially desirable response scale, the Grasmick et al. (1993) self-control scale was shown to be a valid and robust measure of self-control. While the socially desirable response scale marginally attenuates the relationship between self-control and crime it is not enough to make the relationship statistically insignificant (MacDonald et al., 2011). However, the study used cross-sectional data to test this relationship. Gottfredson and Hirschi (1990)

suggest that longitudinal data is unnecessary to answer many theoretical questions; however, longitudinal data must be used in order to test questions about stability.

Certain factors should be addressed when moving forward with the continued exploration and explanation of self-control. One of these factors is Hirschi's (2004) conceptual shift regarding self-control. Many studies testing the ideas found in *A General Theory of Crime* Hirschi (2004) seemed dissatisfied in the way Gottfredson and Hirschi (1990) presented the elements of self-control. This dissatisfaction does not stem from the misinterpretation of the elements. Hirschi (2004) states that the inadequate definitions and explanations of the elements of self-control Gottfredson and Hirschi developed in *A General Theory of Crime* (1990), along with accurate measures of these inadequate definitions have "muddied the waters" (p. 542), subsequently creating four distinct issues that need to be amended. These inadequacies are the result of Gottfredson and Hirschi as well as other researchers including psychological concepts into their thought processes.

First, the elements along with their measures create a sense of motivation within the individual. The original formulation of the theory suggests that motive should be inconsequential with regard to crime and deviance. This is due to the fact that control theories take motive as a given. As previously stated, control theories assume everyone is naturally hedonistic and desire to maximize pleasure and minimize pain. Second, the list of elements and the measures used by researchers contradict the assumption that personality traits do not affect behavioral outcomes. Third, the elements and subsequent measure do not adequately explain how self-control operates. The list of elements and measures only identify traits of individuals who possess low self-control, therefore,

lacking the mechanism by which self-control leads to crime. Lastly, both the elements and measures fail to produce a satisfactory measure that shows more self-control is better than less self-control. Based on this last issue, Hirschi (2004) proposed a variety score that would include the number of different acts (behavioral measures) in order to determine the level of self-control.

Since the genesis of the theory in 1990, self-control has received meticulous scrutiny from researches looking to either prove or disprove Gottfredson and Hirschi's (1990) hypotheses. However, the continued exploration and testing of different facets of self-control theory will allow for more informed policy making and implementation, as well as, a better understanding of crime and criminality. As researchers learn more about dimensionality, group invariance, response bias, and stability it would not be fair to the theory to let the issue die or claim the question has been answered.

Revisions made by the original theorists have changed the conceptualization of self-control. Different arguments can be made about the original theory from 1990 and the updated version in 2004. If the field is concerned with testing the ideas of Travis Hirschi then any addition or alteration to self-control measures should follow his specification. Using measurements that match Hirschi's (2004) specifications have yielded interesting results. Piquero and Bouffard (2007) used Hirschi's (2004) suggestions, testing the updated measure of self-control against the Grasmick et al. (1993) scale. Results show the new measure of self-control to significantly predict deviance while eliminating the main effects between the Grasmick et al. (1993) self-control measure and deviance. Future tests of self-control will have to make the choice

as to whether they are testing Gottfredson and Hirschi's (1990), Hischi's (2004), or the global concept of self-control found throughout academia.

## THE STABILITY HYPOTHESIS

In the section *The Stability Problem* (Gottfredson and Hirschi, 1990:107), Gottfredson and Hirschi outline their theoretical argument for the stability of self-control, what the stability postulate posits, and offer some information about other theories in relation to the stability hypothesis. The primary reason for the assumption that self-control is relatively stable between individuals is the fact that age-crime curve is relatively stable from year to year. Gottfredson and Hirschi (1990) cited several studies (including Goring, 1913 and Neison, 1857), which provide evidence that the age at which people commit crime has not changed in nearly 150 years. Gottfredson and Hirschi (1990) also state that the crime rates among different demographics like sex and race are also invariant over time. The stability of self-control is essential because of the stability of criminal and analogous behaviors.

The stability postulate is a straightforward concept. It posits that an individual's level of self-control does not change throughout the individual's lifetime in relation to others' level of self-control. Stability is divided into two different terms, absolute stability and relative stability. Absolute stability is the individual's baseline stability and, if it exists, remains constant throughout the individual's life course. Therefore, assuming all measurement are valid, if individuals measure their level of self-control at age 15 it will not change if measured again at age 25.

Relative stability is "the probability that two members of a dataset will change rankings on the trait of focus over the course of the study period" (Barnes et al., 2016, p. 321). The concept of relative stability is different and is contingent on the self-control of others along with the self-control of the individual of interest. In other words, an individual's level of self-control is stable in the sense that the individual's relative level ranking among others remains constant over time. For instance, an individual who scores in the 50th percentile on self-control at age 15 will score in the 50th percentile at age 25. However, this does not mean absolute levels cannot change. Absolute levels of self-control among individuals are free to vary but they must vary in unison if relative stability exists. This may be the case, as Gottfredson and Hirschi stated; self-control would appear to increase over time due to the exposure of increased socialization. Stability in the presence of desocialization is rare and the exceptional cases of "good boys gone bad" and late bloomers are more likely the result of measurement error or misidentification (Gottfredson and Hirschi, 1990, pp. 107-108).

Gottfredson and Hirschi (1990) posit that self-control is created through the effective punishment of socially unacceptable behavior. However, Gottfredson and Hirschi (1990) agree that proper socialization is also the role of the educational system. Once children reach the age of eight their level of self-control becomes a stable personality characteristic. Although parents will continue to raise their children until they leave the household, the child's level of self-control will not change dramatically after the age of eight. This type of stability is known as the model of *impressionable years*, in which patterns of behavior become stable after several years of rapid growth between birth and early childhood (Alwin, 1994). This is important because it effectively

categorizes the type of stability Gottfredson and Hirschi (1990) claim self-control to be beyond their absolute/relative dichotomy.

Piquero, Jennings, and Farrington (2010) and Piquero et al., (2016) conducted two meta-analyses to determine if self-control can be improved through intervention at a young age. The studies utilized 41[9] high-quality studies designed to test the effectiveness of programs implemented to improve self-control. Piquero and colleagues did demonstrate that the impressionable years can be used to improve self-control and decrease delinquency. Piquero et al. (2010, 2016) give credence to the Gottfredson and Hirschi (1990) concept that self-control is malleable before the age of 8. This has great policy implications because the meta-analyses show that delinquency decreases when interventions are used. This is important because before these meta-analyses were conducted there was little attention given to the policy implications of Gottfredson and Hirschi's self-control theory (Piquero, 2009).

**Alternative Explanations for Stability**

Several alternative explanations of stability come from different disciplines and run contradictory to the explanations of Gottfredson and Hirschi (1990). Some theoretical explanations of self-control stability are psychological (Nagin & Paternoster, 2000; Moffitt, 1993) where self-control is seen as a manifestation of a persisting individual trait. Other explanations for self-control's stability are sociological and are

[9] There were 34 studies that met the criteria (participants must be under 10 years old, studies must use randomized trials, no timeframe restrictions, etc.) to be included in the Piquero 2010 study. Seven additional studies were added to the original 34 studies in the Piquero et al., (2016) study.

seen as a persisting social environment (Collins, Madsen, & Susman-Stillman, 2002; Steinburg & Silk, 2002). More recently, theoretical work has been conducted to account for the biological influences on self-control stability (Beaver, Connolly, Schwartz, Al-Ghamdi, Kobeisy, 2013; Beaver & Wright, 2007; Beaver, Wright, DeLesi, Vaughn, 2008). However, other researchers do not believe self-control is stable, insisting that self-control is affected by circumstantial situations (Baumeister, Heatherton, & Tice, 1994; Baumeister et al., 2007; Baumeister & Tierney, 2011). This view is similar to explanations for stability, but analyzed from a different perspective.

One theoretical explanation for self-control stability is almost entirely sociological and is influenced by the circumstances each individual's life. The stability of parenting styles during a child's formative years can account for the stability of self-control. This can be loosely tied to the Gottfredson and Hirschi (1990) argument that parents are the primary influence in the development in self-control; however, the concepts remain independent. Gottfredson and Hirschi (1990) maintain that effective parenting, particularly in discipline, leads to self-control; while others (Kandel & Wu, 1995; Loeber et al., 2000) believe consistent, effective parenting, in a general sense, leads to stability and higher levels of self-control.

Consistent parenting styles should not be interpreted at face value. It is vital for the development of the child and self-control for parenting styles to evolve with the age of the child. It is common in early child to use strict, coercive punishments to deter bad behavior in the future. However, as the child becomes an adolescent the parenting style changes to include techniques like reciprocity and fairness to achieve desired outcomes (Collins et al., 2002; Steinberg & Silk, 2002). Despite the argument made for consistent

parenting and its influence on stability, Gottfredson and Hirschi would suggest this concept is simply a more elaborate explanation of effective parenting.

Gottfredson and Hirschi (1990), as well as some of the most recent authors of self-control (Hay & Meldrum, 2015), subscribe to the adage that the best predictor of future behavior is past behavior. Self-control, by some (Nagin & Paternoster, 2000; Moffitt, 1993, Wilson & Herrnstein, 1985), is seen as a latent trait. Latent traits are intrinsic qualities possessed by the individual and dictate future behavior. Thus, individuals commit criminal acts or, in the context of the theory, lose self-control because it is simply who they are. These individual characteristics effect the ability to control emotions, thoughts, or actions (Nagin & Paternoster, 2000) and can be characterized by researchers in the field of psychology as having antisocial potential (Moffitt, 1993). While Moffitt (1993) did not use the specific term "self-control" she did create a parallel concept called "cross-situational consistency". Individuals who possess the latent trait commit criminal acts along with several behaviors analogous to crime that were outlined by Gottfredson and Hirschi (1990). In a similar way, Moffitt (1993) uses the term "persistence" in place of the word "stability". While the terms are different, they do represent the same concept in the context of absolute and relative stability. Individuals with low self-control will continue to exhibit life-course persistent criminal and analogous behaviors. Additionally, the age-crime curve is a very stable (relatively speaking) predictor of crime for life-course persistent offenders, a concept that is also addressed by Moffitt (1993). This persistence is also impervious to sociological interactions such as fluctuations in social status or environment.

The psychological concept of the latent trait is just one explanation for the stability of self-control. For the most part, it would seem that the field of psychology endorses the idea of a stability postulate when referring to self-control. However, not all members of psychological research accept the idea that self-control is stable (Baumeister et al. 1994; Muraven et al. 1998; etc.). The concept of self-control remains the same between these two areas of research, but the fundamental assumptions about the stability of self-control are very different.

Muraven and Baumeister (2000) posit the concept that self-control can resemble a muscle that can get tired and fail in time. The ability to resist temptation refers to an individual's self-control strength. This muscle analogy suggests that self-control is not only a trait but also a state or status that fluctuates over time. Like a muscle, self-control can be "exercised" and gain strength. However, after considerable use self-control can fail much like a muscle after over exertion in a gym (Baumeister et al., 1994; Baumeister et al., 2007; Baumeister & Tierney, 2011).

Additionally, the strength model of self-control can be tied to biological aspects of self-control, a self-control paradigm ignored in the past and an area of thought condemned by Gottfredson and Hirschi (1990) and have supported their claim by saying "…biological positivism has produced little in the way of meaningful or interpretive research" (Gottfredson & Hirschi, 1990:61-62). However, there may be more to the biological explanation than Gottfredson and Hirschi (1990) claim. The muscle metaphor may be more than an analogy. The brain uses 20% of the calories processed by the body, yet only amounts to 2% of the body's mass (Baumeister & Tierney, 2011). Because the brain uses so much energy, depriving this organ that is responsible for decision-making

and ultimately self-control, could be detrimental to self-control strength. Gailliot et al., (2007) tested this concept by manipulating glucose levels in test subjects and subsequently testing their self-control. Individuals who were manipulated to be glucose deficient performed worse on self-control tasks than individuals who had normal levels of glucose. The evidence supporting a biological mechanism affecting self-control has led to subsequent studies examining sleep and its effects on self-control, which have yielded results that reinforce prior research (Abe, Hagihara, & Nobutomo, 2010; Meldrum, Barnes, & Hay, 2013; Barnes & Meldrum, 2014).

There are additional sociological explanations for self-control stability that influence parenting. Individuals who live in impoverished, socially disorganized neighborhoods exhibit lower levels of self-control when compared to their more affluent counterparts. Interestingly, these levels of self-control continue to remain statistically significant even after controlling for parenting styles (Pratt, Turner, & Piquero, 2004; Teasdale & Silver, 2009). These studies suggest that individuals faced with a situation of chronic poverty may account for lower levels of self-control that are independent of parenting.

Living in a state of constant poverty can have a substantial effect on emotional and physical health of the family (Maholms & King, 2012). This negative effect can then trigger a behavioral response that affect parenting styles. Rijlaarsdm et al. (2013) found that poverty increases the stress levels of the parents, which are associated with depression and the willingness to use harsh or physical forms of punishment. Gottfredson and Hirschi (1990) posit that punishment and discipline are essential for the development of self-control. While there are many forms of punishment that are not

physical or abusive, Romer (2010) found evidence to suggest that physical forms of punishment and abuse have a negative impact on the development of self-control. However, even when the punishment is appropriate and would not be considered abuse some studies have shown little support that discipline and punishment influence the development of self-control (Hay, 2001; Latimore, Tittle, & Grasmick, 2006; Nofziger, 2008).

The exposure to poverty and its effects on family dynamics are often quite stable. For instance, children who are raised in the lowest economic income bracket or the bottom 20% of income earners will most likely be part of the same economic bracket as adults. This could be the result of street-code values in which a subculture devalues and discourages self-control (Anderson, 2000; Miller, 1958; Wolfgang, Ferracuti, & Mannheim, 1967). Adolescents growing up in disorganized neighborhoods, with a divergent culture to mainstream society, do not envision themselves achieving success via socially acceptable norms and encourage the impulses that would prevent that success from ever happening (Drummond, Bolland, & Harris, 2011; Piquero, 2014). Parents, other family members, or influential people in the community can instill this mentality. This stable indoctrination could account for the stability of low self-control in these neighborhoods and conversely high stable self-control among affluent neighborhoods.

Additional concepts that may explain self-control stability may manifest themselves in the form of state dependence. State dependence refers to a kind of contagion where past events affect the probability of future events occurring (Nagin & Paternoster, 1991). Exhibiting signs of low self-control, such as, crimes or analogous behaviors, labeling those children, and associating them with the behaviors they carry out

will influence future behavior. The children will then assume the persona given to them and continue to exhibit similar behavior (Jussim & Harber, 2005). As these children continue to commit acts of deviance, and associate with deviant peers, they become more entrenched in their label making it more difficult to change. This cumulative disadvantage can account for the stability seen in delinquency as well as those who rarely or never engage in criminal acts (Sampson & Laub, 1997). Gottfredson and Hirschi would posit that the concept of cumulative disadvantage is merely function of low self-control; however, the cumulative disadvantage theory does explain, in greater detail, how self-control theory can invoke a strong stability argument. While the concept of state dependence is intriguing, it tends to ignore the possibility of an individual's willpower to continue down a certain path or change their current state.

Tittle, Ward, and Grasmick (2004) explored the idea that an individual's preference or interest to exercise self-control may operate independently from an individual's capacity to exercise self-control. Until Tittle's and colleagues' (2004) study, most self-control studies only assessed the correlations between an individual's capacity to exercise self-control and (dependent variable) or some other theoretically interesting question. Tittle et al. (2004) found that an individual's desire to exercise self-control predicts at least some measures of crime and/or deviance. Additionally, the desire and capacity to exercise self-control have a cumulative, as well as, interactive effect when predicting crime and deviance. This may suggest that the stability of self-control may arise as a function of willpower to exercise base level self-control.

There are some issues that hinder the interpretation of Tittle et al's., (2004) results. One of the critiques is the generalizability of the results because the sample is not

representative of the population. The sample came from primarily people living in an urban setting; therefore, the study surveys individuals who are disproportionately exposed to correlates of crime. Another limitation is how *self-control desire* is measured. It is possible that there could be some overlap between *self-control desire,* opportunity, and motivation which could render the association between *self-control desire* and crime at least partially spurious. Tittle et al., (2004) suggest direct measures of all these variables should be used in future tests in order to determine if self-control desire has an actual effect on crime and delinquency.

**Empirical Standing of the Stability Literature**

The amount of knowledge about self-control stability has increased steadily since it was first tested in the late 90s (Arneklev et al., 1998) and has now become a topic of increased interest in the field of criminology (Diamond, Morris, & Piquero, 2015). While the initial tests provided support for the stability thesis the short timeframe in which the test was conducted limited the amount of change possible by the subjects (Na & Paternoster, 2012). The law of longitudinal relationships suggests that as the timeframe between measurements increase the evidence for stability declines (Moffitt, 1993). However, this decline could be due to measurement error (Alwin, 1994; Asendorpf, 1992). Human development varies dramatically between people and within people over their life-course, making appropriate measures at "time 1" effectively inappropriate at "time 2". Evidence for greater stability could be achieved if appropriate measures were used (Clarke & Clarke, 1984). One interesting phenomenon that occurred more than once in early research is the ability of some individuals to move from one extreme level of

self-control to the other. For instance, some individuals who started with the highest levels of self-control dropped to be some of the lowest by the end of the study. This shift was also experienced by a few individuals who tested among the lowest in the beginning of the study but found themselves to possess some of the highest levels of self-control by the end of the study (Burt et al., 2006; Hay, Meldrum, Forrest, & Ciaravolo, 2010)[10].

Continued research garnered evidence that did not support the Gottfredson and Hirschi hypothesis in which self-control is stable after age 8 (Burt et al., 2014). This is because better analytic techniques to detect difference over time became more commonplace. Group-trajectory models have been invaluable for determining developmental trajectories of self-control. Early tests confirm that the majority of participants possess absolute stability over time (Forrest & Hay, 2006). Forrest and Hay, (2006) used the NLSY79 which collect data every two years over a roughly nine-year timeframe resulting in five waves. Additional findings by Higgins, Jennings, Tewksbury, and Gibson (2009) and Ray, Jones, Loughran, and Jennings (2013) report similar results. However, all of these studies found that a significant minority within the sample experienced a significant amount of instability. Furthermore, this significant minority (sometimes only around 5% of the sample) represented different group trajectories (Forrest & Hay, 2006).

Gottfredson and Hirschi (1990:108) claim that any instability found can be attributed to misidentification or measurement error. However, there is evidence that does not support this aspect of self-control theory. In addition to finding instability

[10] The timeframe separating each wave was two years in these respective studies. There were no additional waves after collecting the second wave of data.

through the use of hierarchical linear modeling and latent growth curve modeling, Na and Paternoster (2012) used a "second-order latent growth curve model" (McArdle, 1988) to show the findings are not an artifact of measurement error. Na and Paternoster (2012) also ran additional models, including a group-based trajectory model, that also indicated instability of self-control. The unanimity of the results suggests there is instability at least within their particular dataset.

An interesting addition Na and Paternoster (2012) made to the stability literature is the noticeable effect social bonds have on the growth of self-control stability. However, the model fit was poor which may have been due to poor measures of social bonds. Additionally, while not discussed in the study, it should be noted that the relationships calculated in this study are linear. While the traditional latent growth models are conducted under linear assumptions they can assume more complex trajectories given that multiple waves of data are gathered. Multiple waves (10) of data were gathered in Na and Paternoster's (2012) study; therefore, an interesting follow-up study should take these into account. While this is just one suggestion using a specific dataset, the questions this study, along with several other studies produce, insure that the testing of self-control stability is a fruitful area of research that deserves attention.

Additional contributions to the stability literature come from Diamond et al. (2015) in which, she and her colleagues tackle the issue of self-control constructs. In the past, all studies testing the stability hypothesis wanted to find whether self-control changed relative to participants in the sample. Diamond et al. (2015) noticed in a previous study (Burt et al., 2014) that certain components changed much more than other components. Diamond et al. (2015) found participants who scored high on impulsivity in

earlier waves scored lower on impulsivity on subsequent waves. Additionally, two other dimensions that fail to be relatively stable were attention and emotional regulation. Diamond et al. (2015) concluded that relative instability seemed to be the rule as opposed to the methodological exception proposed by Gottfredson and Hirschi (1990) and determined that 75% of individuals reported instability in at least one self-control construct.

However, a recent study by Barnes et al., (2016) believes that the analytic techniques used in the past to answer questions of relative stability are appropriate. Barnes et al., (2016) state that relative stability is defined as "the probability that two members of a dataset will change rankings on the trait of focus over the course of the study period". This definition possesses a problem for multilevel modeling and group-based trajectory modeling because there is no parameter that directly estimates this probability. Therefore, Barnes et al., (2016) created an analytic strategy they call P(Δ), in which P = *probability* and delta = *reliable.* This method uses the reliability assessment taken from the Reliability Change Index (RCI) (Christensen & Mendoza, 1986) combined with the logic of the Spearman rank-order correlation. While this new technique can effectively determine the probability of relative stability in a dataset it cannot determine how much rank-order change needs to occur before its deemed statistically significant. Therefore, additional work is still required to determine whether relative stability of self-control exists.

Many studies conducted in recent years have raised new questions regarding the stability hypothesis. While the most recent studies suggest that the question of whether stability exists should be laid to rest stating there is enough evidence to assume the

stability postulate is false (Burt et al, 2014), the research must now turn to the nature of stability and characteristics of stable as well as unstable members. The mixed research cannot lead to a determination that self-control is stable or otherwise. Continued research and the refinement of statistical techniques, particularly in using $P(\Delta)$, should be undertaken in order to make a more informed conclusion regarding the stability hypothesis.

**Why Would Self-Control Change in the Short-Term?**

There are several reasons why self-control may not be relatively stable in the short-term. Each explanation relies on the individuality and possible personality differences between subjects. Baumeister et al., (2007) have used their strength model to explain how people can lose self-control but also how people gain self-control. Experimentation has shown evidence to support the idea that people lose self-control when their self-control is tested or challenged. However, it is understandable that people will fail in exercising self-control sooner than others and it would also be logical that people would differ in the amount of time it takes people to regain their baseline level of self-control. In this same vein, state dependence can also affect people differently. Events that occur in the beginning of the week can greatly influence an individual's behavior or mentality later in the week; however, the degree to which these past events affect each individual can be due to personality differences or something else entirely.

Biological influences can also change an individual's level of self-control for a day or even several days. If an individual does not sleep or does not sleep well he or she will suffer from a diminished level of self-control for a day or more or until the individual

can rest properly. This can also be said blood sugar levels. If an individual fails to eat then their blood sugar levels may drop resulting in decreased levels of self-control. Stress can also change the amount of self-control an individual has at a particular moment but as stress or strains are relieved it may also translate into increased levels of self-control. Additionally, peer influence can change the amount of self-control an individual has at a given moment. Gardner and Steinberg (2005), have also experimented using the presence of peers and their influence on behavior. The presence of peers may change an individual's self-control from a behavioral perspective by increasing the frequency at which people engage in risk seeking behavior and possibly the attitudes that individual has about themselves. Each of these theoretical models could possibly be used to explain why self-control instability in the short-term could be present but could not be detected in a study using less waves with greater lengths of time between waves.

In order to determine whether self-control stability does change in the short-term a pilot study was required to gauge the effectiveness of the research methodology. When this survey technique is employed it must withstand the high dropout rates that are expected. It is much easier to expect participants to complete one cross-sectional survey but asking them to complete 12 surveys in relatively close succession creates a greater burden on the participant. The current study to seek to answer several questions.

There are three primary research questions in the current study, and they are:

*1. Is self-control relatively stable in the short-term?*

*a. If self-control is not stable what variables contribute to that instability?*

*2. Is there a difference in the stability of behavioral measures of self-control and attitudinal measures of self-control?*

*3. Does the Law of Longitudinal Relationships drive the stability of self-control?*

## THE SHORT-TERM STABILITY OF SELF-CONTROL: A PILOT STUDY

The overall objective of the pilot study was to inform and support the efforts of completing the current study. The pilot study tested the methodological requirements needed to test the theoretical assumption that self-control is a stable personality construct that was proposed by Gottfredson and Hirschi (1990). According to Gottfredson and Hirschi (1990) self-control is defined as "the tendency of individuals to pursue short-term gratification without consideration of the long-term consequences of their acts" (p.177). The psychology literature has defined self-control as "the exertion of control over the self by the self" (Muraven & Baumeister, 2000, p.247). Despite the similarities between definitions these two fields have tested this concept in different ways and have different assumptions about self-control's properties. Past studies testing Gottfredson and Hirschi's concept of self-control have used data gathered with years separating each wave with little thought to the short-term changes to self-control (Barnes et al., 2016; Na & Paternoster, 2012). The pilot study attempted to identify whether the methodology employed in the pilot study could be used to identify self-control (in)stability in the day-to-day activities of life.

**Data and Sample**

The target population for this study was college students enrolled in undergraduate, criminal justice classes at the University of South Carolina during the summer semesters. This did not exclude anyone based on race, sex, or gender; however, students were required to be legal adults to participate (18 years old). As of the fall 2015 semester, there were currently 4 students who were 16 years old attending the university. While it was highly unlikely they would be selected, they would have been prohibited from participating in the study. Additionally, graduate students would also have been prohibited from participating. The target sampling size for this pilot study was 30 subjects. All 147 students who took criminal justice classes during the summer three semesters of 2016 were included in the sampling frame. The initial sample size was 38 individuals; however, 8 people dropped out resulting in a final sample of 30 participants that completed all waves.

The selection of the sample was done via email. The entire population of students was selected from the sampling frame and emailed an invitation to participate in the study. This invitation email used the Criminal Justice/Criminology department's list of students taking the classes, and then the students' email addresses were searched in the university directory to recruit potential participants. The number of students selected to receive an invitation were based on the fact that many were not expected to participate. After the invitation emails were sent there was a final composite sample of 38 students. The email stated the purpose of the study along with the information required to participate. The pilot study used an app service participants could download for free from the app store and be used on either Apple or Android platforms. The invitation

email stated they can simply enroll in the study by downloading the app, enter their name, create a password, and enter their email address, the final step was to enter the access ID number indicated in the email. This ID number made them part of the panel I created directing their survey responses to the primary investigator. Once the app was downloaded, a consent document was embedded in the first survey (Demographics). The subject was required to acknowledge they have read the informed consent message and understood it before any survey questions could be answered. The demographics and delinquency measures can be viewed in Table 2.1 and Table 2.2 below.

Other studies in criminology have used cellphones to collect data but none of these studies have used a smartphone application and these studies were cross-sectional (Burraston, Cherrington, & Bahr, 2012; Van Gelder & Van Daele, 2014). Data gathering software such as SurveyMonkey and Qualtrics have the ability to send surveys to email addresses and can be completed on a smartphone or table. This existing software is designed with smartphone use in mind and allows the researcher to view what the survey would look like if you open the survey on a smartphone. It is not possible to use software like SurveyMonkey and Qualtrics for this study because they do not permit the collection of longitudinal data on the same persons.

One of the only studies in criminology to use cellphones as a medium for panel survey research was conducted by Naomi Sugie (2014). Sugie's study tracked 135 men released on parole. In Sugie's (2014) study she conducted a pilot study with 13 released inmates before recruiting the 135 men used in the full study. Sugie (2014) used a

smartphone application she created herself[11]. The current study will be a pilot study much like Sugie's before a larger study in the future.

**Data Collection**

The pilot study used the internet as a medium to administer the surveys; therefore, participants were required to have a smartphone with the capability to use applications (apps) in order to receive and complete surveys. Smartphones capable of mobile internet is preferred over short message service (SMS) because SMS is limited to 160 characters. Additionally, surveys using SMS suffer from higher attrition rates, especially in surveys asking more than 10 questions. While this eliminates potential participants who use flip phones, another phone system, or no phone, the likelihood of sampling an individual who uses a phone other than a smartphone is small. As of 2013, 91% of Americans owned a cell phone but only 61% owned a smart phone (Smith, 2013). Smartphone ownership continues to be the highest among young adults (ages 18-29), with high income, and education levels. As of early 2014 smartphone ownership reached 85% among the 18-29 age demographic (Pew Research Center, 2015) and can only be expected to increase during the 2.5 years since these data were last gathered. Because the vast majority of college students (96.5%)[12] are members of this demographic, the probability of selecting a significant number of non-smartphone users was expected to be quite small. The survey measuring repeat levels of self-control was constructed using a software package

[11] Sugie did not write the code and create the app per se but she did fund the creation of the application for this specific project.
[12] This statistic is based on the enrollment of all University of South Carolina undergraduate students in the fall of 2015.

called Survey Analytics, which is a part of the larger company, QuestionPro. This software allows for the creation of surveys and their dissemination to respondents via an application. When the respondents finished each survey, the data were transmitted back to the licensee of the software. The data was then exported to an excel file so it could be imported in R for statistical analysis. SurveySwipe is the name of the application and was provided free of charge for the pilot study.

The 4 waves of surveys were administered at random, over a one week time period. Currently, there is no "best practice" in the field of survey research using mobile phones as a primary mode of data collection (Link et al., 2014). Randomly administering surveys was designed to achieve many things but in the pilot study it was specifically important for one reason. This study did not assume that administering surveys every day, every other day, or other systematic survey administration was better or correct; additionally, the survey did not create any bias or prime respondents to expect surveys on specific days. If respondents were primed to think they will be completing surveys on a specific day of the week they may alter their behavior prior to completing the survey.

**Focus Group**

IRB confirmed that if a participant agreed to be part of the survey portion of the project then they agreed to the possibility of being contacted about all subsequent forms of data collection including focus groups. IRB also informed the research team that consent forms specific to the focus group were not required and stated the consent agreement originally made by the participants also covered this phase of the project.

Table 2.1 Sample Descriptive Statistics Pilot Study

| | M | S.D. | Min | Max |
|---|---|---|---|---|
| Age | 22.6 | 4.2 | 19 | 38 |
| Delinquency involvement | 27.3 | 1.6 | 21 | 28 |

M = Mean
S.D. = Standard deviation

Table 2.2 Sample Descriptive Statistics Pilot Study (Continued)

| | Frequency | Percent |
|---|---|---|
| Sex | | |
| Male | 20 | 52.6 |
| Female | 18 | 47.7 |
| Race | | |
| White | 26 | 68.4 |
| Black | 9 | 23.6 |
| Hispanic | 1 | 2.6 |
| Asian | 1 | 2.6 |
| Other | 1 | 2.6 |
| Education | | |
| Freshman | 1 | 2.6 |
| Sophomore | 3 | 7.9 |
| Junior | 10 | 26.3 |
| Senior | 24 | 63.2 |
| Childhood home intactness | | |
| Mother Only | 9 | 23.7 |
| Father Only | 1 | 2.6 |
| Both Parents | 26 | 86.4 |
| Other | 2 | 5.2 |
| Childhood residence | | |
| Farm | 1 | 2.6 |
| Rural | 9 | 23.7 |
| Small Town | 7 | 18.4 |
| Big Town | 6 | 15.8 |
| City | 15 | 39.5 |
| Current residence | | |
| On-Campus | 24 | 63.2 |
| Off-Campus Apt. | 13 | 34.2 |
| Off-Campus House | 1 | 2.6 |

After all 4 waves of data were collected the initial sample (38 students) were emailed and asked to participate in a focus group. The subjects who wished to participate in the focus group responded to the email. All participants who indicated that they wanted to be part of the focus group were sent a follow-up email detailing where and when the focus group would take place. Because of the limited response rate achieved during the data collection phase a random sample taken from the original 38 members may have generated an insufficient number or maybe even zero focus group participants.

The ideal focus group size is usually between 5-8 people; however, the pilot study was only able to recruit 4 participants for the focus group. Considering the fact that the pilot study was 1) a pilot study, 2) participants probably have little experience using this methodology, and 3) the anticipated low levels of enthusiasm subjects would have for research methodology allowed for the final size of the focus group size without ill effects (Krueger & Casey, 2015).

The participants were allowed to eat pizza and drink the beverages before the focus group started. This was done in an attempt to make the participants feel more comfortable in space where the focus group took place. Additionally, the food was provided before the focus group in order to give the participants a chance to develop a limited rapport with each other as well as the researcher. The participants were not told where to sit but they naturally gravitated toward one side of a particular table to sit and eat before the focus group started. The researcher pulled up a chair on the opposite side of the table and set up the MacBook Air, to record the focus group, to the participants' left and to the researcher's right.

Participants were instructed that the focus group questions were regarding the methodology of the study and at no time were participants asked to divulge information about answers to the questions in the survey stage of the study. This focus group interaction used open ended questions to inform the researchers how the participants responded to using an app as a means by which to complete surveys, questions and their characteristics, as well as the compensation given to subjects.

Table 2.3 Focus Group Topics

| Items |
|---|
| 1. Recruitment |
| Content |
| Length |
| Concerns about validity |
| 2. The smartphone application |
| Ease of use |
| Completing surveys |
| Level of convenience |
| Concerns about confidentiality |
| 3. Survey content |
| Question quality |
| Number of questions |
| Time investment |
| Concerns or apprehension about answering questions |
| 4. Compensation |
| Level of compensation |
| Kind of compensation |
| Ease of recouping compensation through the app |
| 5. Open forum |

Approximately 3-4 focus groups would be used in an ideal study using focus groups because this is when theoretical saturation is likely to occur (Krueger & Casey, 2015). The pilot study used a single-category design with only one focus group. While this is not ideal, the pilot study attempted gain as much insight into subject participation

as possible. Throughout the focus group, subjects were asked individually whether they wanted to add anything to the discussion if they did not provide any information during a particular topic. The focus group lasted around 42 minutes. Participants were compensated in the form of a $10 cash payment and food for their participation in the focus group.

The researcher used a set of categories and questions that are listed in Table 2.3 to stay on topic and maximize the amount of information gathered during the focus group. In order to gather as much information as accurately as possible the focus group was recorded using the audio recording software and transcribed. These comments were easily referred to when revising the methodology to improve efficiency and effectiveness.

**Protection of Human Subjects**

EXISTING DATA/SAMPLES:

The pilot study data was stored on the Question Pro servers until the end of the data gathering phase of the project. The primary server was in Seattle and the secondary server was in Philadelphia. After the completion of each survey the data resided on these servers until the data was exported to a password protected computer. Question Pro then deleted the data when the trial subscription expired.

One benefit to using an app to gather data on cell phones was that phone numbers were not required by the researcher to send or track the participants. Subjects were required to enter a name in order to install the app on their phone but subjects could have entered a pseudonym if they wished. An email address was also required to fully install the app and to redeem compensation at the end of the study. The only identifier used to

track each subject was an "external ID number" which was a random number generated and assigned by the Survey Swipe software. The email addresses were kept on record during pilot study so the participants could be contacted for the focus group. However, during the primary data collection phase of the dissertation the email addresses will not be kept on file.

Lastly, there was no data stored on the participants' phones. When surveys were completed (or even uncompleted surveys) the information was automatically transferred to the Question Pro servers. This automatic transfer of information freed the participant from manually submitting responses and keeps their responses safe even if their phone was lost, stolen, or used by someone other than the owner of the phone. If a participant's phone was lost or stolen they may continue from a new cell phone. They would simply download the app again (if necessary) and enter the same registration information they inputted the first time they enrolled in the project. The Survey Swipe software would recognize the user and allow them to keep entering responses as if nothing ever happened. Only one participant notified the primary researcher that their phone was stolen and was unable to participate in the pilot study. Although the participant was informed that continuing the study was a possibility, contingent on getting a new phone, the participant decided to drop out.

CONSENT/ASSENT:

After downloading the app, the participants received a notification to fill out a survey. This was not an automatic process, the principle investigator had complete control over when each survey was distributed and their notifications. The consent form

appeared when they clicked into that first survey, marked “Consent and Demographics”. The form read as follows:

> Hello:
>
> You are being asked to volunteer for a research study conducted by Nicholas Blasco, a doctoral candidate in the Criminology and Criminal Justice Department at the University of South Carolina. The purpose of this study is to ascertain information about short-term stability of self-control. You are being asked to participate in this study because you are an undergraduate student majoring in criminal justice. This study is completely voluntary and all of your answers will remain confidential. You may choose to skip questions you do not want to answer. An example of a question you will be asked is, “In the past couple days how many times have you arrived late to class”? This study is being done remotely, over the phone via a mobile app, SurveySwipe, and will involve approximately 30 volunteers. You will compensated $10 for completing all four surveys ($2.5 per survey). You may redeem your compensation in the app under profile and rewards. Surveys will be automatically submitted by the app why the questions are complete. Each survey will only take 1-2 minutes to take. By clicking the “I agree” button below you are acknowledging that you have read this and fully understand it. If you have any questions please contact Nicholas Blasco by email: blascon@email.sc.edu or phone: (717) 991-7851. Thank you very much for your time and support.
>
> Thank you very much for your time and support. Please start with the survey now by clicking on the <B>Continue</B> button below.

The “<B>Continue</B>button” in the consent form was simply code in the software. The participants saw a checkbox with the words “I agree” beside it. By clicking the box, they notified that they have read the document and agreed to participate in the study. Participants were not able to proceed to any other questions unless they consented using this method. Consent forms like the one used in this pilot study have been used since the introduction of internet/intranet to collect data for survey or experimental research (Schmidt, 1997; Smith & Leigh, 1997).

To avoid coercion, potential participants read the email and decided for themselves whether to enroll in the study or simply ignore the email. This indirect interaction between researcher and potential participant minimized the potential for coercion.

POTENTIAL RISKS:

The potential risks posed to the participants were minimal; however, they did provide some personal information. The participants reported about some of their daily behaviors such as cheating on exams or minor offenses like not wearing seat belts. No risk to physical or mental health was anticipated.

As stated above, there was no data stored on the participants' phones. When surveys were completed (or even uncompleted surveys) the information is automatically transferred to the Question Pro servers. This automatic transfer of information freed the participant from manually submitting and kept their responses safe even if their phone is lost, stolen, or used by someone other than the owner of the phone. If a participant's phone is lost or stolen they may continue from a new cell phone. They would simply download the app again (if necessary) and enter the same registration information they inputted the first time they enrolled in the project. The Survey Swipe software would recognize the user and allow them to keep entering responses as if nothing ever happened.

CONFIDENTIALITY

Participants were required to enter a name and email address to download the app. These data remained confidential, but were not used to track participants. Participants were tracked using an external ID number that was randomly generated by the Survey Swipe software and assignment to each account user.

Participants were assured privacy and confidentiality by means of a secure, password protected computer system (Macbook Air). The computer remained on the researcher at all times. If the computer could not remain in the direct possession of the primary investigator it was locked securely in a room. The Macbook Air was equipped with "File Vault" to ensure no unauthorized access. Additionally, the folder containing the data was encrypted with a 128-bit AES encryption code to help protect these data. To further assure confidentiality and security, QuestionPro has been made SSAE 16 (SOC 2) compliant, audited by a third party, and EU and Swiss SafeHarbor certified. Their primary server is based in Seattle and a secondary in Philadelphia. The data were permanently deleted from these servers after the pilot study was completed.

QuestionPro employees had access to all data when they were on their servers; however, they are instructed to not disseminate any information or data. All QuestionPro employees have signed a document pledging that they would not compromise any information received while working for QuestionPro. All QuestionPro employees have also been instructed that they may be sued by their clients or may face criminal prosecution for compromising or disseminating information or data on the QuestionPro servers. These steps were taken by QuestionPro for the protection of research subjects.

COMPENSATION:

Survey Swipe and Question Pro have an interesting way to compensate subjects. Researchers informed Question Pro how much participants would receive per survey ($2.5 per survey in the current study) and then that money came in the form of a Visa electronic gift card. Other options are available such as Starbucks gift cards; however, the Visa electronic gift card is more versatile and can be used anywhere that accepts major credit cards. Participants in the focus group agreed with this rationale and preferred the Visa electronic gift card over the other options. The gift cards are sent to the subjects' accounts and are available for electronic download. The $1 compensation or something of commensurate value (Ballivian, Azevedo, & Durbin, 2015) has been used to effectively used in the past to compensate participants for their time and is considered the going rate for short, mobile surveys (Wells, Bailey, and Link, 2014). However, due to other demands placed on the subjects the compensation was increased to $2.5 per survey in the pilot study. Participants were asked to complete the survey as soon as they received the survey instead of completing it at their own convenience. Participants had the opportunity to earn a total of $10 for completing all waves of the pilot study.

This amount was carefully considered and was not a completely arbitrary decision. Past research on incentives and compensation using landlines was evaluated because there is currently no research regarding compensation using mobile apps to complete surveys. Research has shown that promised compensation ranging from $5-$25 does not significantly increase response rates (Cantor, Cunningham, & Giambo 1998; Kropf, Sheib, & Blair, 2000; Singer, Van Hoewyk, & Maher, 2000); however, promised

compensation of $35 can increase the response rate by 16% (Strouse & Hall, 1997, May). Members of the focus group confirmed what past research has found about compensation and response rate. Interestingly, all members of the focus group indicated that they would have been willing to complete the surveys for free.

The age of the participant[13] and whether there is a prepaid component along with the promised compensation can influence response rates; however, these variables have no effect on adults without children (Cantor, Wang, & Abi-Habib, 2003). The increased response rates seen in the past experiments suggests a degree of coercion is influencing the subjects to participate. The pilot study was designed to remain free of any coercive effects seen in age, monetary compensation, or parental status. Gault, Reichlin, Reynolds, and Froehner, (2014) found that 26% of college students are raising children that depend on them as primary care givers. While parental status may pose a problem for response rates the remaining effects of age and monetary reward are easily controlled for in the study.

Participants were compensated if a subject chose to participate in the focus group after all waves of the study were finished. Compensation of $50-$75 is considered fair for focus groups (Krueger & Casey, 2015); however, this compensation would not be financially viable. Therefore, a mixed monetary and non-monetary form of compensation was used to stay within the ability of the study to conduct a focus group without the subjects feeling disappointed. A monetary compensation of $10 along with

[13] It is important to note that the age range that is affected by compensation is 0-17 years old. The current study excludes anyone under the age of 18; therefore, the response rate should not be effected by age or compensation in this study.

the promise of light refreshments and food was given to participants who chose to participate in the focus group. Non-monetary compensation, such as food has been shown to be effective at making participants feel they were compensated fairly (Krueger, & Casey, 2015).

WITHDRAWAL:

Participant autonomy was respected and they were able to skip questions they did not feel comfortable answering and were able to drop out of the study at any time. Simply deleting the app would effectively eliminate them from the study; however, they could have rejoined the study at any time by redownloading the app. Compensation is given for each completed survey, participants may skip questions with no penalty to compensation; nevertheless, they were required to complete the survey to receive compensation for that survey.

## Measures

**Self-control (Attitudinal).** Because the testing of short-term stability of self-control is still in its infancy the pilot study along with the dissertation should be considered exploratory studies. Grasmick et al.'s (1993) scale was used to measure attitudinal/cognitive levels of self-control throughout the study. The original 24 item measure of self-control was cut down into a more concise 6 item scale. While this may seem like a limitation, it was intended to limit the attrition due to an excessively long instrument. Turner and Piquero (2002) had success in using a 6 item attitudinal measure of self-control in their study of self-control stability. Each of the items used the 4-point

scales measuring each of the items just like the original Grasmick et al. (1993) study. The 4-point Likert-type ordinal metric used to measure each of the self-control items are: (1) strongly agree, (2) agree somewhat, (3) disagree somewhat, (4) strongly disagree. The Grasmick et al. (1993) scale was used because it has been extensively used to test Gottfredson and Hirschi's version of self-control (Pratt & Cullen, 2000). Additionally, there is confidence in the Gramick et al. scale because it has been tested on its dimensionality, validity, and reliability (Piquero & Rosay, 1998; Vazsonyi et al., 2001; 2003). A precursor statement to the attitudinal items of self-control read, "Answer the following questions with regard to how you feel since the last survey taken".

Table 2.4 Attitudinal Measure of Self-Control

| Items |
|---|
| 1. I much prefer doing things that pay off right away rather than in the future. |
| 2. I frequently try to avoid things that I know will be difficult. |
| 3. Sometimes I will take a risk just for the fun of it. |
| 4. I like to get out and do things more than I like to read or contemplate ideas. |
| 5. If things I do upset people, it's their problem, not mine. |
| 6. I lose my temper pretty easily. |

All Likert items are answered on a 4-point scale of strongly agree (1), agree somewhat (2), disagree somewhat (3), and strongly disagree (4).

Reliability measures were moderate at best resulting in Alphas ranging from .5 to .61; however, Turner and Piquero (2002) had similar Alpha estimates in their study. The items that comprised the attitudinal measure did not scale well which may or may not be a result of the small sample size. In order to help correct this issue from occurring in the main data collection phase of the project the number of attitudinal self-control items will be doubled to 12. Additionally, the items will be slightly altered to be more sensitive in

an effort to detect change. A subsequent factor analysis will determine which components or factors should be deleted in order to increase the Cronbach's Alpha to an appropriate level without sacrificing the integrity of the self-control construct.

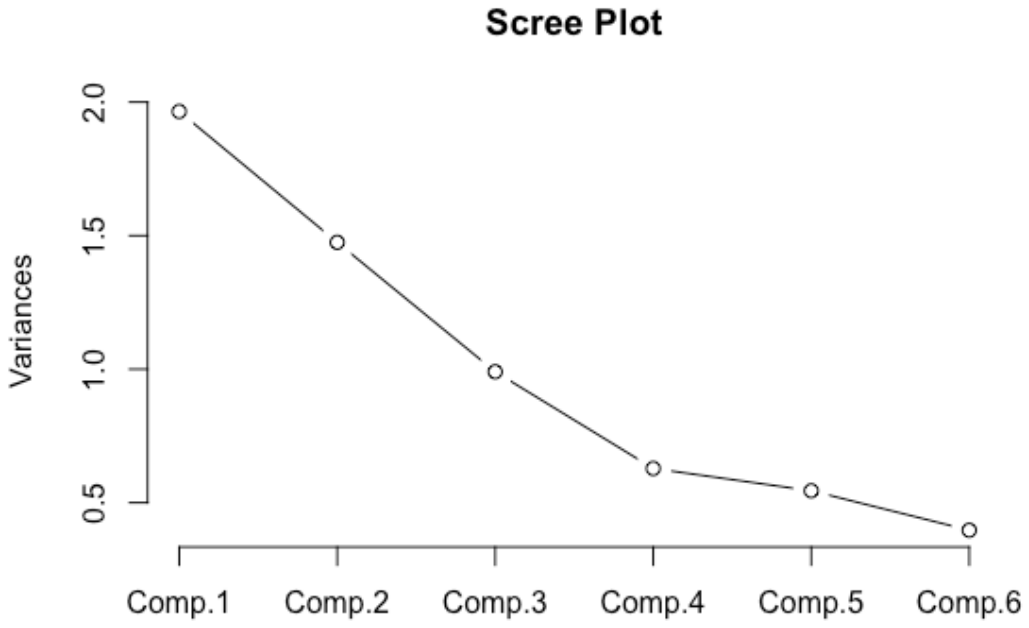



Figure 2.1. Scree plot for attitudinal self-control measures in pilot study

A principal component factor analysis was conducted in order to justify the creation of single scales for each element of self-control as seen in previous studies; however, due to the low sample size the Eigenvalues did not justify this action. The factor Eigenvalues for each attitudinal self-control component were 1.40, 1.21, 0.99, 0.79, 0.73, 0.63. According to the Kaiser Rule, all factor Eigenvalues below 1 should be rejected (Nunnally, 1967); however, the Scree Discontinuity Test, or simply creating a

scree plot, suggests the natural cut off point be between the third and fourth factor and can be visualized in the Scree Plot below (Cattell, 1966).

**Self-control (Behavioral).** Gottfredson and Hirschi (1990) insist that behavioral measures are preferred over attitudinal measures of self-control. While there has been evidence to show that there is no difference between attitudinal and behavioral measures when it comes to predicting delinquency (Tittle, Ward, & Grasmick, 2003) there is also support for Gottfredson and Hirschi's preference (Evans et al., 1997; Paternoster & Brame, 1997). However, there has been little attention given to the stability of these two self-control constructs with some exceptions (Turner & Piquero, 2002). While attitudes and beliefs may remain constant the manner in which low self-control manifests itself through behavior may change greatly from day to day. Therefore, measuring these manifestations of low self-control during the pilot study was not only an unprecedented study of self-control stability but it was an attempt to understand how self-control varies in our daily lives through actions free of any socially desired response bias[14]. Building on the work of Turner and Piquero (2002) the pilot study separated and tested attitudinal and behavioral measures of self-control. However, unlike Turner and Piquero's (2002) study where behavioral measures were collected during childhood and attitudinal measures were collected during adolescence the pilot study collected them at the same time.

[14] Burt et al. (2014) used both attitudinal and behavioral measures of self-control during their stability tests; however, they did not parcel out whether behavioral or attitudinal were more stable than the other.

These behavioral response measures of self-control were administered using the smartphone application. The measures consisted of 6 items. Some of these measures were adapted from the Behavioral Problems Index (BPI), a well-validated inventory used in the National Longitudinal Study of Youth (NLSY) (Zill & Peterson, 1986) and has been used in many prior studies to test self-control (Pratt, Turner, & Piquero, 2004; Raffaelli, Crockett, & Shen, 2005; Turner & Piquero, 2002). However, it was altered in several ways to accommodate the waves. One way that the inventory was altered was through the response options. A 7 point continuous response for each item measuring self-control was: 0 through 6 or more. How the question was asked was another way the inventory was changed. Instead of asking how true the item was, the respondent was asked how many times they have engaged in the following acts since their last survey. For example, at the beginning of the behavioral self-control section of the survey, before the questions were asked, the survey prompted the participants to answer, "Since the last survey, how many times did you…" Additional items came from adapted behavioral self-control measures used by Tittle et al. (2003) or were created by the author for the specific purpose of the pilot study. If the subject indicated that they consumed alcohol since the last survey they completed the survey software proceeded to the question, "Get drunk". The 'Get drunk' measure had a 4 point ordinal, Likert type scale: (1) Not at all, (2) Buzzed, (3) Drunk, (4) Blacked out. If the subject indicated that they did not consume alcohol since the last survey they completed then the skip logic built into the software automatically skipped the 'Get drunk' question and proceed to the next item.

Table 2.5 Behavioral Measures of Self-Control

| Item |
|---|
| 1. Drink alcohol |
| a. Get drunk |
| 2. Use tobacco products |
| 3. Skip class |
| 4. Cheat or tell lies |
| 5. Not wear a seatbelt |
| 6. Arrived late to class |
| 7. Have difficulty concentrating or paying attention |
| 8. Act cruel to others |

All continuous items are answered on a 7 point scale of 0, 1, 2, 3, 4, 5, 6 or more.

A principal component analysis was also conducted for the behavioral measures of self-control. The results were similar to the attitudinal measure of self-control revealing only several components with sufficiently high eigenvalues. The factor eigenvalues for the behavioral components of self-control were 1.68, 1.35, 1.08, 0.95, 0.87, 0.73, 0.62, 0.55, 0.48. The Kaiser rule suggests that only the first three components should be kept in the study. Unlike the attitudinal measure of self-control there is no natural break in the scree plot as seen below; therefore, it would be understandable to adhere to the Kaiser rule in this instance.

**Delinquency Involvement.** The link between low self-control and crime has been well established (Pratt & Cullen, 2000). Pratt (2016) has even said the need to continue this line of literature is no longer necessary. However, studies should continue to include measures of crime and delinquency even if they are not the key variables of interest. These crime measures can be used as a validity check to effectively determine that the self-control measures did capture what they were intended to capture. The pilot study

used measures of delinquency derived from the NLSY. These 14 measures of delinquency are dichotomous in nature (1 = yes, 0 = no) and was assessed at the end of the study.

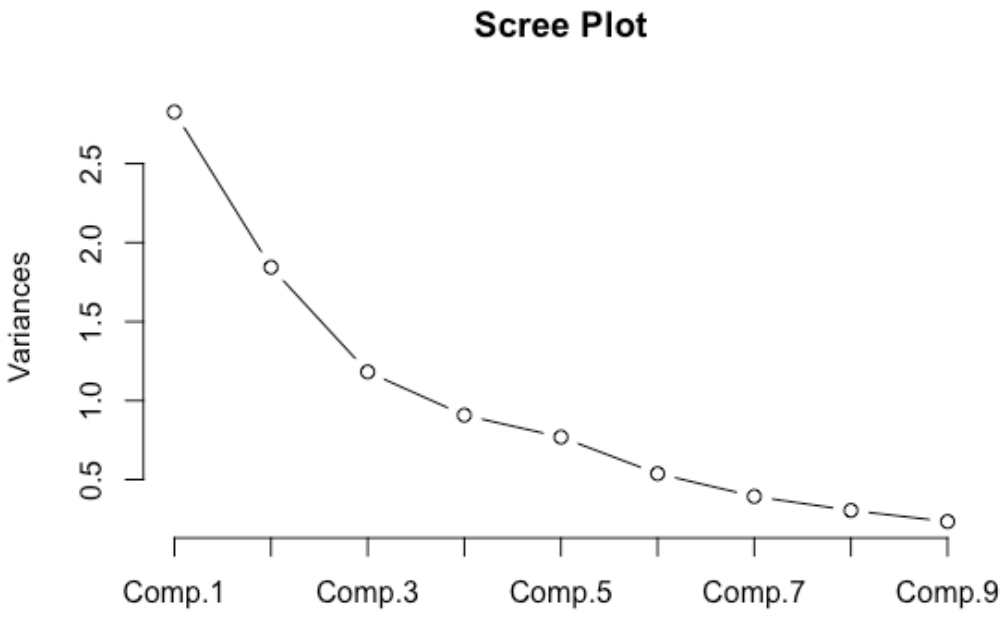



Figure 2.2. Scree plot for behavioral self-control measures in pilot study

The 14 measures had responses of, "In the past month, have you ever…" The only thing that has been altered from the NLSY version of this measure is the time duration.

Table 2.6 Measures of Delinquency Involvement[15]

| Item |
|---|
| 1. Intentionally damaged or destroyed |
| 2. Got into a fight at school or work |
| 3. Taken something without paying for it |
| 4. Taken something worth under $50 |
| 5. Taken something worth over $50 |
| 6. Used force to get money from someone |
| 7. Hit or seriously threatened someone |
| 8. Attacked someone with the idea of seriously hurting or killing them |
| 9. Tried to con someone |
| 10. Taken a vehicle without the owner's permission |
| 11. Broken into a building or vehicle to steal something |
| 12. Knowingly sold or held stolen goods |
| 13. Helped in a gambling operation like running numbers or books |
| 14. Hurt someone badly enough to need bandages or a doctor |

All dummy items are answered as either Yes (1); No (2)

**Time.** Time is at the very heart of testing stability. Age has commonly been used in past studies (Burt et al., 2014; Hay & Forrest, 2006; Turner & Piquero, 2002) and age measured in years is common for most. However, the pilot study took place over the course of one week instead of years; therefore, using age in terms of years is not a viable variable. In the pilot study, the smartphone application software automatically records a time stamp that indicates when each survey was completed. These time stamps were then recoded in order to test time in terms of days and hours

[15] An error was made during the operationalization of the pilot study's crime measures. The crime measures were referred to as delinquency measures by mistake. All of the participants were at least 18 years old and therefore no longer qualify as delinquents. The surveys were administered using the term delinquency so the title remains in this table. It should be noted this oversight was corrected before the current study administered the crime involvement survey.

**Control Variables**

In addition to the variables above, a number of control variables were included in the analysis including sex, race, age, education, childhood home intactness, childhood residence, and current residence. These demographic variables were collected at the beginning of smartphone data collection phase but not during any of the subsequent waves of data collection. The reason for this was twofold; first, these variables are constants and therefore will not change during the course to the study. Second, decreasing the number of superfluous variables during the self-control data collection phase should have decreased the likelihood of participants dropping out of the study due to such a long survey.

Time constant variables include a dummy variable for *sex* (1 = male, 0 = female) and a nominal variable, *race* (1 = white, 2 = black, 3 = Hispanic, 4 = Asian, 5 = other). *Age* (18-88) was also controlled for and measured in years. The rationale for measuring age this way comes from Tittle and his colleagues (2003; 2004) in which they used a range from 18-88. Traditionally, education has been measured by alternative measures (Tittle et al., 2003; 2004); however, the pilot study had a relatively homogeneous sample in terms of education. Because of the sample's homogeneity, education was measured using an ordinal scale from freshman (1) through senior (4). Childhood home intactness comes from the studies by Tittle et al. (2003; 2004) in which they sometimes referred to as "childhood family intactness" or "childhood family structure". The pilot study used the same operationalization of childhood home intactness as Tittle and colleagues by asking their respondents, ''think back to when you were growing up: in general, which of

the following describes your family situation?'' Most of the time, you were living with (1) your mother or mother-figure (like a stepmother); (2) only your father or a father-figure (like a stepfather); (3) both your mother (or mother-figure) and father (or father-figure); (4) other. It is understood that many children grow up with only one parent; therefore, the following responses was scored accordingly: ''1'' for ''only father...'' and ''other''; ''2'' for ''only mother...''; and ''3'' for both parents, whether biological or surrogate. Child residence was in five categories (1) farm; (2) in a rural area, but not farm; (3) small town of 10,000 or less *not* located near a bigger city; (4) small town of 10,000 or less located near a bigger city; and (5) city of 10,000 or more. Finally, the current residence was where the student was living while they completed the pilot study. The current residence variable was measured by asking the respondent to identify whether they lived in on-campus housing (1); off-campus apartment housing (2); off-campus house (3).

Surveys taken on a smartphone take longer to complete than taking a survey on a desktop computer. Several different reasons can account for the delay including, the slow nature of cellular networks or Wi-Fi connection, the difficulty of reading questions on a small screen, and the increased distractions when people use smartphones instead of sitting at a desktop computer (Couper & Peterson, 2016). Some of these problems may be mitigated by the increased size of many smartphone platforms. Several phones, such as the iPhone 6 Plus, have become known as "phablets", a combination of the words PHone and tABLET. The larger screens may allow participants to read the surveys better therefore increasing their response rates and decreasing attrition. However, this has yet to

be addressed in the research so the direct result of using phones of varying sizes is unknown.

## Analytic Strategy and Results

The pilot study was simply the predecessor to the much larger current study; therefore, the amount of analytic work was minimal. However, the fact that this was a pilot study does not diminish the importance of the data that came from the study. First, one of the most important statistics was the response rate (25%) from sending out the invitation emails.

Once the data were collected descriptive statistics were calculated. This was necessary in order to conclude the sample was representative of the population or not. Frequency distributions of self-control measures were also calculated. Additional analyses were conducted on the measures themselves including factor analyses and ordinal Cronbach's alphas. These analyses revealed if there was anything inherently wrong with the measures that may need revision for the current study.

The focus group provided valuable information regarding research methodology and its effectiveness. The allow members of the group spoke individually and expressed independent ideas their ideas often paralleled each other. Additionally, the focus group members tended to speak, or at least communicated, in a collective manner. This allowed for a modicum of generalization to the pilot study sample.

Focus group members agreed that the recruitment email's content was unimportant and were ultimately enticed by the compensation they would receive. However, when asked about compensation they all reported that it did not influence them and actually said they would have completed all waves of data for free. This is interesting

in terms of recruitment and retention. However, there were issues with recouping the compensation requiring some troubleshooting with the software company.

The data collection process was done through a smartphone application. Like most applications, the notifications can be altered or even turned off. Some of the focus group members admitted to turning the auditory notification off but left the banner/visual notification on. Despite some members changing the notification settings, the majority of members said they completed the surveys as soon as they were aware of the active survey. Focus group members collectively agreed that the surveys were not an inconvenience in regard to the length of each survey, survey content, or the number of questions. In fact, the majority of focus group members said they would be willing to complete even more questions.

## Discussion

The pilot study was a proof of concept to ensure the current study would be successful. A primary learning objectives where successfully met and a unique finding was made. First, survey methodology can successfully be used on a mobile platform. Second, the measures and their delivery can be administered with less apprehension than the literature seems to suggest. These two discoveries helped determine the feasibility of the project as well as inform how to change the methods so they are the most effective.

Several different survey platforms have the capability to conduct survey research on phones but using applications for smartphones is still in its infancy. Additionally, using applications for testing theoretical hypotheses has yet to be thoroughly explored.

The pilot study showed it is possible to use a smartphone application to collect survey data to answer questions not possible if traditional survey methods were employed.

The past literature warned against the use of long surveys or wordy questions (Callegaro, 2010; Wells, Bailey, and Link, 2013; Bosnjak et al. 2013). However, subjects who participated in the focus group insisted that longer, more detailed surveys would not fatigue them to a point where they would quit. This was shown quantitatively by the leveling off of attrition rates in the pilot study. The current study used a larger survey instrument in an attempt to capture self-control more accurately. The attrition rates during pilot study increased confidence in the length of the project. The attrition rates appeared to level off indicating an initial drop in participation but a substantial remaining sample that would continue completing surveys throughout the project duration.

## The Current Study

Pratt (2016) stated that researchers need to conceptualize and measure self-control as a *dynamic* criminogenic risk factor. The dynamic viewpoint of self-control was determined by the need to couple life-course criminology and self-control theory which is driven by the social consequences of self-control along with the apparent instability found in psychological and criminological studies (Burt et al., 2014, Hay & Forrest, 2006, Na & Paternoster, 2012). Pratt's (2016) suggestion, coupled with past research (Burt et al., 2014, Hay & Forrest, 2006, Na & Paternoster, 2012) providing evidence refuting the original stability hypothesis posited by Gottfredson and Hirschi (1990), guided the current study to determine whether self-control can change and the extent to that change. Burt et al., (2014) identified that self-control can change over wavelengths

of many years, but how does that change occur? Burt et al., (2014) shows that self-control changes incrementally over time yielding significant differences over many successive years. The current study attempted to observe the daily changes in self-control that may contribute to the change seen by Burt and colleagues.

Additionally, this study tried to examine the differences between attitudinal and behavioral measures of self-control. Important questions still need to be answered when considering the stability of these two constructs. If attitudinal and behavioral measures of self-control appear to have differences in stability then it could change how self-control is tested and how it's analyze deviant behavior.

The current study was a natural extension of the pilot study. The theoretical rationale remained unchanged and the knowledge gained helped to improve the methodology for the current study. The largest change came in the form of different measures for self-control. Additional changes came in the form of increased sample size as well as additional waves. Naturally there was more complex statistical analyses to answer several research questions.

# CHAPTER 3

# METHODOLOGY

## DATA AND SAMPLE

The present study uses survey data obtained from undergraduate students attending a university in the southeastern United States. All 1155 undergraduate students enrolled in a criminal justice course were included in the sampling frame. All other enrolled students were excluded from the study because their lifestyle, study and work routines are very different from undergraduate students. For similar reasons, part-time students were also excluded from the sampling frame. Additionally, the sample only included students that meet the previous demographics who are currently taking a course in the department of criminology and criminal justice.

### Sample Size and Selection

Invitation emails were drafted in a similar to the pilot study; however, a few changes were made. An example question was included in the invitation email that demonstrated the sensitivity and personal nature of some of the questions. Additionally, members of the pilot study's focus group indicated that some doubts of legitimacy were raised because the invitation email came from a student. The committee chair's name and email address were included in the email because the focus group said they would feel a greater sense of security and confidence if the major professor and his contact information were included in the email. The invitation email included instructions on

how to download the smartphone application from either Google Play or the iPhone App Store and enter the panel set up for this particular study. The software would then assign participants random identification numbers to protect their identity and allow them to be tracked over time.

There were 300 subjects who agreed to participate in the study by downloading the application. However, a number of subjects dropped out or participated in different phases of the project. 165 participants completed all surveys in their entirety. However, depending on the analysis completed cases were not always necessary. Analyses that did not require completed cases used a sample size of 266; this number reflects the participants who did not participate in at least one wave. Table 3.1 show the attrition rates throughout the study and the manner in which subjects participated. It should be noted that 96.6% (257 participants) of all participants in the study completed wave 1. Symmetrically, 3.4% (9 participants) did not complete the first self-control survey but participated in some capacity after wave 1. Sometimes a participant completed only one wave while others jumped in and out throughout the study. These 9 participants were not included in the table, nor were they included when creating Figures 3.1 and 3.2, because

**Table 3.1** Attrition between waves

| **Wave** | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***n*** | 257 | 244 | 236 | 232 | 227 | 221 | 220 | 214 | 206 | 196 | 190 | 165 |
| ***n*%** | 100 | 94.9 | 91.8 | 90.3 | 88.3 | 86.0 | 85.6 | 83.3 | 80.6 | 76.3 | 73.9 | 64.2 |
| **A%** | - | 5.1 | 3.1 | 1.5 | 2.0 | 2.3 | 0.4 | 2.3 | 2.7 | 4.3 | 2.4 | 9.7 |
| **CA%** | | 5.1 | 8.2 | 9.7 | 11.7 | 14.0 | 14.4 | 16.7 | 19.4 | 23.7 | 26.1 | 35.8 |

*n* = sample size
*n*% = Proportion of the sample remaining
A% = Attrition from wave-to-wave
CA% = Cumulative attrition

they do not accurately measure attrition. The sample size reflects the fact that each participant completed the current wave and all previous waves. Therefore, the measures for attrition and the proportion of the sample remaining reflect the people who completed all previous waves but did not complete any successive waves. Figure 3.1 shows the cumulative number of participants who dropped out through the course of the study. This pattern is fairly linear and appears to indicate participants simply fatigued and dropped out.

Arneklev et al. (1998) used a sample of 127 college student in the first study to test Gottfredson and Hirschi's stability hypothesis. While sample sizes can reach into the tens of thousands to test stability (Coyne, Vaske, Boisvert, and Wright, 2014), it is not required to achieve sufficient statistical power. Additionally, reviewing literature using similar methodology can also shed light on a proper sample size. One of the only studies in criminology to use cellphones as a medium for survey research was conducted by Naomi Sugie (2014). Sugie's study tracked 135 men released on parole.

The selection of the sample was done via email. The entire population of 1155 students meeting the previously stated criteria were included in the sampling frame because the number of anticipated dropouts and low response rate. The response rate for the email invitation and completing the first wave of surveys was about 23%. Breakoff rates and the risk of attrition is higher in studies using mobile devices in survey methodology (Callegaro, 2010; Wells, Bailey, and Link, 2013; Bosnjak et al. 2013).

Breakoff rates[16] were nonexistent during the pilot study which may be due to the fact that the surveys were short and easy to fill out. A similar situation was experienced during the primary data collection of the current study. Frustration and boredom was probably kept to a minimum because of the easy nature of the survey. The attrition rate[17] seemed to level off by the third wave and did not drop at all from the third to fourth wave of the pilot study. However, during the data collection of the current study a leveling off did not occur. In fact, by the half way point in the study an email had to be sent out to help encourage continued participation in the study. This appeared to momentarily stop the attrition, shrinking the attrition rate to only .4%. However, the effect of this email lasted only for one wave and attrition continued at rates similar to those before the email was administered. Figure 3.2 shows where and to what degree this drop occurred.

**Data Collection**

Several problems materialized by the time the current study started. These issues delayed the start of the data collection process by 10 days. This delay may have caused a greater number of participants to passively quit the project. Although it cannot be accurately determined, an assumption can be made that the participants who passively quit before the project's start were more likely to possess lower levels of self-control. Arneklev et al., (1998), found participants who had lower levels of self-control compared to the rest of the sample were less likely to participate in the follow-up survey. A higher

[16] Breakoff rates refer to the rate at which people quit in the middle of a survey.
[17] Attrition rates refer to the rate at which people drop out of a study after initially participating.

rate of low self-control participants quitting before the start of the project could have subsequently skewed the results.

The current study, like the pilot study before it, used the internet as a medium to administer the surveys; therefore, participants were required to have a smartphone with the capability to use applications (apps) in order to receive and complete surveys.

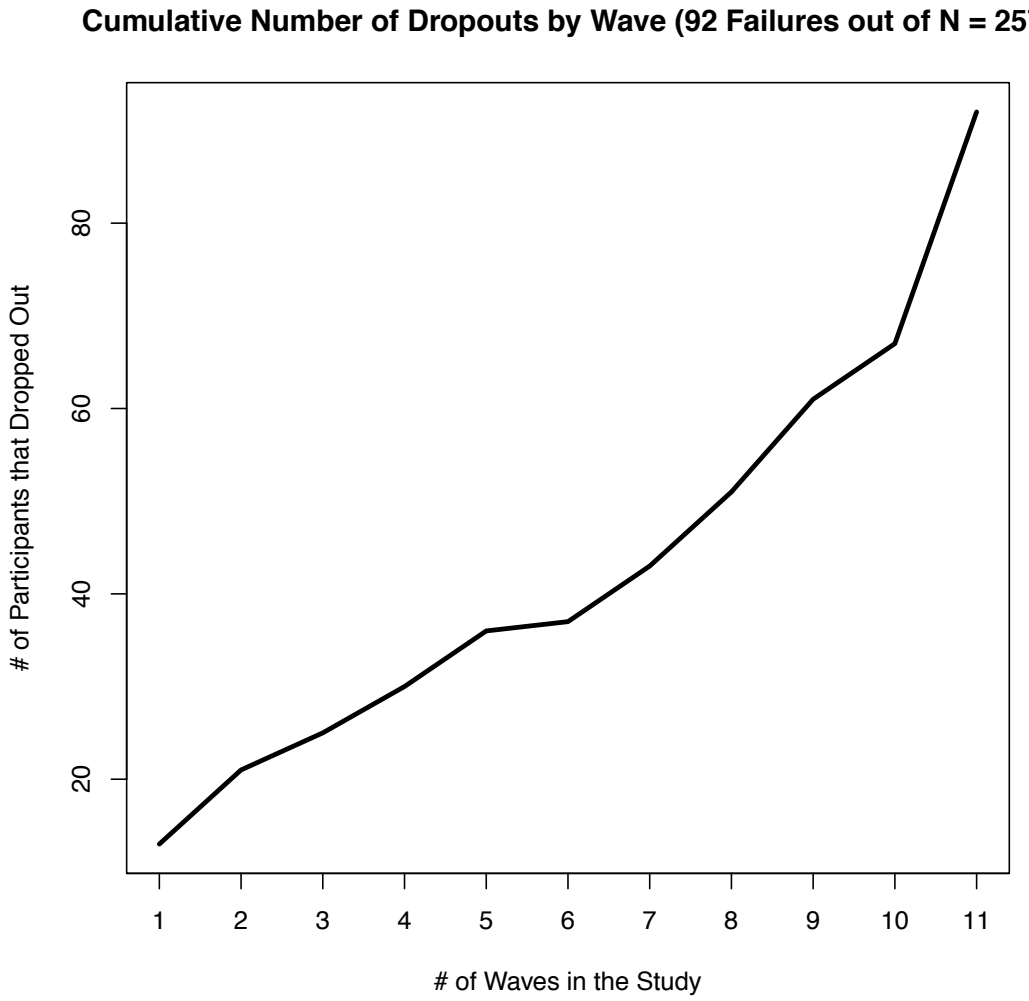



Figure 3.1 The Cumulative Number of Dropouts by Wave

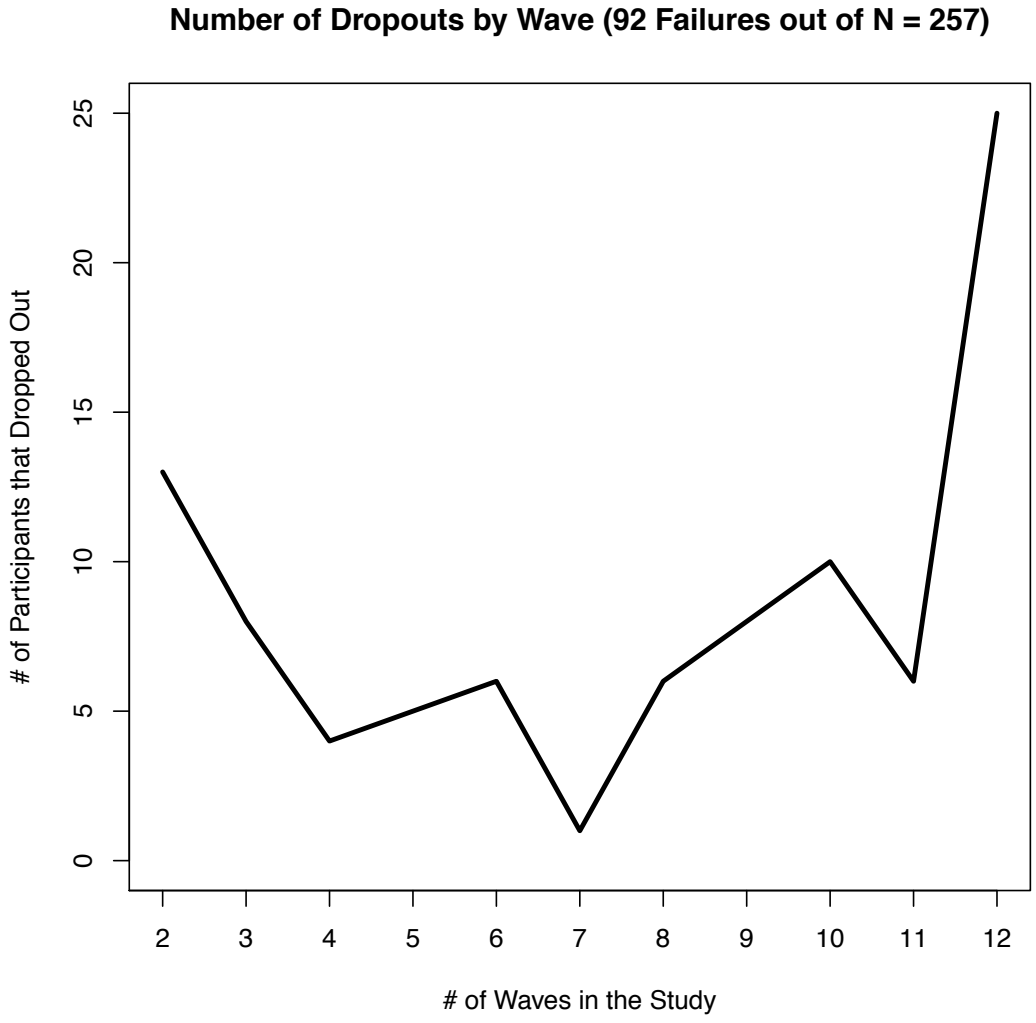



Figure 3.2 The Number of Dropouts by Wave

Smartphones capable of mobile internet is preferred over short message service (SMS) because SMS is limited to 160 characters. Additionally, surveys using SMS suffer from higher attrition rates, especially in surveys asking more than 10 questions.

Using an application is beneficial over simply filling out the surveys on the phone's internet browser for several reasons. First, it is ideal the participants are notified they have a survey to complete and subsequently complete the survey as soon as possible.

The auditory and vibrating features of the app's notification was actually an issue early in the pilot study but was resolved before the first wave received their emails. There was no notification during the tests of current surveys which resulted in the delay of the launch. There is no guarantee the participant would be alerted of an email, this may result in the email sitting in their inbox for hours or even days before being completed. This assumption was actually confirmed in the focus group. Second, if the participant opens the survey on a phone's web browser the responses for each question may not fit on the screen. This would require participants to scroll through responses to choose their desired answer. Not only does this increase the completion time of the survey but it affects how participants respond to questions. Past research has found participants who are forced to scroll through potential responses are more likely to simply chose the first option available, also known as the primacy effect (Peytchev & Hill, 2010; Wells, Bailey, & Link, 2014). This has also been found in another study to see if this phenomenon held true if the response scale is reversed (Stapleton, 2013). The primacy effect has been documented with mail and online surveys (Dillman, 2000). Using a smartphone application solves notification and primacy effect problems. First, participants will receive visual, vibration, and/or auditory alerts prompting them to complete surveys. Although this seems like a desirable feature, several focus group participants turned off the application's vibration and auditory alert notifications. Focus group participants almost solely relied on the banner notifications (visual) to be informed of a survey. However, the focus group participants did say they would take the survey as soon as they saw a survey was made available. Second, smartphone applications present the question

and all response categories on the same page which has shown to eliminate the primacy effect (Wells et al., 2014).

Using a smartphone application is also beneficial for ensuring the respondent completes the survey on the intended platform. There is little to no difference between completing surveys online verse a smartphone app in terms of quality (Andreadis, 2015; De Bruigne &Wijnant, 2013; Peytchev & Hill, 2010; Wells et al., 2014). If participants have the ability to open surveys on a variety of devices some participants will complete surveys on a device which they were specifically instructed not to (see Wells et al., 2014). This results in what is called treatment attrition, in which participants complete the measure but abandon the assigned treatment (Shadish, Cook, & Campbell, 2002). Treatment attrition and primacy effects can be avoided by implementing a survey design, like a smartphone app, in which the survey must be completed through app with no other alternative.

While this eliminates potential participants who use flip phones, another phone system, or no phone, the likelihood of sampling an individual who uses a phone other than a smartphone is small. As of 2013, 91% of Americans owned a cell phone but only 61% owned a smart phone (Smith, 2013). Smartphone ownership continues to be the highest among young adults (ages 18-29), with high income and education levels, and as of early 2014 smartphone ownership has reached 85% among this age demographic (Pew

Research Center, 2015) and can only be expected to increase during the 2.5 years since these data were last gathered. Because the vast majority of college students (96.5%)[18] are members of this demographic, the probability of selecting a significant number of non-smartphone users would be quite small. The pilot study relied solely on this probability and was unable to determine if there were potential participants who wanted to participate but were unable to given this limitation.

The survey measuring repeat levels of self-control were altered from their original, pilot study construction using the same software package called QuestionPro. This software allows for the creation of surveys and their dissemination to respondents via smartphone application. When the respondents finished each survey, the data were transmitted back to the licensee of the software. The data were then exported to a excel or CSV file, just like the pilot study, for analysis. QuestionPro has a product called Survey Analytics with an application called SurveySwipe. This application was used in the pilot study and was used again in the current study.

A total of 12 surveys were systematically administered in a one month time span. Currently, there is no "best practice" or optimal design in the field of survey research using mobile phones as a primary mode of data collection (Link et al., 2014; Peytchev & Hill, 2010) and the pilot study was not conducted to determine an optimal design. First, this study did not assume that administering surveys every day, every other day, or other systematic survey administration is better or correct. Second, when stability of behavior is measured, the coefficients are higher the closer Time1 is to Time2 (Moffitt, 1993).

[18] This statistic is based off of the enrollment of all University of South Carolina undergraduate students in the fall of 2015.

This coefficient gets smaller as the time between surveys increases. According to Gottfredson and Hirschi, self-control is stable over time. However, if self-control is unstable, as some research suggests, then there may be a significant time effects on self-control stability.

The participants were asked to fill out a survey called "Demographics" at the beginning of the study. The advantage of this, other than collecting descriptive data, is the chance to, replicate past studies such as the one conducted by Arneklev et al. (1998). However, the current study expanded on the study conducted by Arneklev because of the additional data gathered between the time points that Arneklev did not collect.

Table 3.2 presents the descriptive statistics for the "Demographics" survey at the start of the study, the end of the study, and who those proportions compare to the student population. This allows for the visualization of how the sample has changed from the beginning of the study to the end. Arneklev et al. (1998) experienced higher attrition among males and blacks. Although blacks tended to drop out of the study more than whites, the number of drop outs of was not substantial.

In the current study, sample sizes for males and females were disproportional to the population. Poststratification was used to help determine if this difference had a meaningful effect. Poststratification uses sampling weights that sum to the population size within each poststratum (Gelman & Little, 1997). The population size of both males and females is 35,481 undergraduate students enrolled on the main campus. The number of male undergraduates was 15,348 while the number of female undergraduate students totaled 20,133. These figures served as the poststratum weights for male and female. Mean estimates for self-control were almost identical for weighted (female: $\mu = .36$, *SE* =

.01; male: μ = .38, *SE* = .00) and unweighted measures (female: μ = .36, *SE* = .01; male: μ = .38, *SE* = .00) for sex. Therefore, the underrepresentation of men and overrepresentation of women in the sample did not have a significant effect on the overall patterns of relatively stable self-control levels for the sample as a whole. Figure 3.3 presents a graphical depiction of weighted and unweighted means of self-control for sex at each wave. Just like the poststratum weights for all combined waves, the individual waves show little difference between weighted and unweighted means of self-control for sex. Each of the numbers beside the data points represent the purged (void of missing data) sample size that was used to calculate the weighted means.

**Protection of Research Participants**

Potential participants were not coerced into participating in the study and were not punished in any way if students decide not to participate. The consent form in the first survey thoroughly informed the potential participants of the goals the current study and informed them of the potential risks.

The potential risks posed to the participants were minimal; however, they did provide some personal information. The participants reported about some of their daily behaviors such as cheating on exams or minor offenses like not wearing seat belts. No risk to physical or mental health was anticipated during the pilot study; therefore, no warnings were given. However, participants may feel compelled to complete the survey even when they are in a dangerous situation. Participants will be cautioned not to

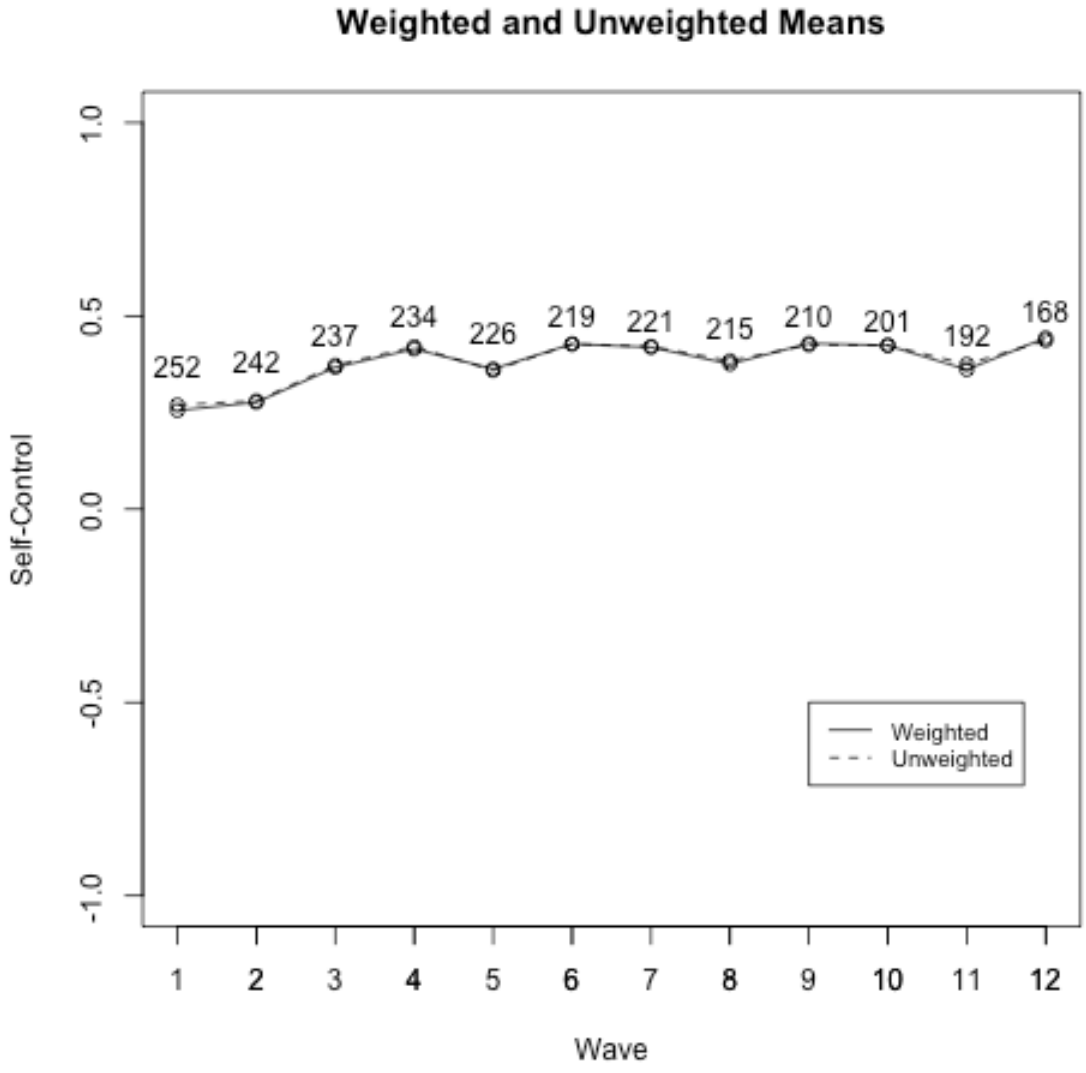



Figure 3.3 Weighted and unweighted means of self-control for sex

complete surveys as they drive a motor vehicle or walking in areas where they could fall and injure themselves due to not paying attention. Despite these precautions it was revealed that participants were still using cell phones while driving. Although it cannot be determined if any participant completed surveys while driving, participants did admit to texting, calling, or communicating while driving.

Table 3.2 Descriptive statistics for constants

| | Sample Proportion | Full Completion | Drop outs. | Population Proportion. |
|---|---|---|---|---|
| Sex | | | | |
| Male | 24.71 | 23.31 | 26.37 | 43.25 |
| Female | 75.29 | 76.69 | 73.63 | 56.74 |
| Race | | | | |
| White | 76.86 | 77.91 | 73.63 | 76.7 |
| Black | 15.69 | 14.72 | 18.68 | 10.2 |
| Hispanic | 1.96 | 2.45 | 1.10 | 4.0 |
| Asian | 2.75 | 2.45 | 3.30 | 2.3 |
| Other | 2.75 | 2.45 | 3.30 | 6.8 |
| Education | | | | |
| Freshman | 17.65 | 19.63 | 14.29 | 22.13 |
| Sophomore | 21.57 | 19.63 | 24.18 | 19.08 |
| Junior | 27.45 | 27.61 | 27.47 | 28.38 |
| Senior | 33.33 | 33.13 | 34.07 | 29.04 |
| Childhood Home Intactness | | | | |
| Mother only | 22.92 | 20.99 | 26.67 | - |
| Father only | 2.37 | 0.62 | 5.56 | - |
| Mother and Father | 72.73 | 75.93 | 66.67 | - |
| Other | 1.98 | 2.47 | 1.11 | - |
| Childhood Residence | | | | |
| Farm | 3.14 | 3.68 | 2.20 | - |
| Rural | 13.33 | 12.27 | 15.38 | - |
| Small town not near city | 13.33 | 13.50 | 13.19 | - |
| Small town near city | 35.69 | 36.81 | 32.97 | - |
| Urban | 34.51 | 33.74 | 36.26 | - |
| Current Residence | | | | |
| On-campus housing | 21.96 | 24.54 | 17.58 | - |
| Off-campus apartment | 41.57 | 41.72 | 40.66 | - |
| Off-campus house | 33.73 | 30.67 | 39.56 | - |
| Other | 2.74 | 3.07 | 2.20 | - |
| Age[19] | 20.29 | 20.34 | 20.21 | 20.2 |

Total sample size = 266
Full completion sample size = 163
Drop outs sample size = 91
Population size = 23302[20]

[19] These are not percentages but they are averages of the sample and the population.
[20] This reflects the entire student population not just the sampling frame (students enrolled in a criminal justice class).

COMPENSATION AND BUDGET

## Compensation

Survey Swipe and Question Pro have an interesting way to compensate subjects. Researchers purchase rewards by placing money into an account set up on the Survey Analytics website. An inventory of prepaid Visa gift card valued at $20 per card was created. In order to successfully redeem compensation for the study subjects had to earn points by completing the surveys. One hundred and twenty points must be earned in order to receive compensation. Each survey was worth 10 points and there was a total of 14 surveys (a demographics survey, crime measures survey, and 12 waves of self-control surveys). This means participants had the ability to earn 140 points; this difference is designed to prevent dropouts. There was a two-part rationale for lowering the threshold by 20 points from the maximum to prevent dropouts from occurring. It is inevitable that some subjects would not complete surveys for whatever reason; however, any additional information they provided was valuable, particularly for the group-based trajectory models and multi-level models. Therefore, to prevent these participants from being discouraged from completing future surveys because they knew they would not be paid there was a 20 point handicap that allowed participants to miss two surveys without penalty. This threshold was also designed as a minimum benchmark that must be reached in order to redeem the compensation. This means participants cannot enter the study and immediately dropout for the sole purpose of earning a quick $20.

The $1 compensation or something of commensurate value (Ballivian, Azevedo, & Durbin, 2015) has been used to effectively used in the past to compensate participants for their time and is considered the going rate for short, mobile surveys (Wells, Bailey,

and Link, 2014). However, due to other demands placed on the subjects the compensation was increased to about $1.43 per survey in the current study. Participants were asked to complete the survey as soon as they received the survey instead of completing it at their own convenience. The total compensation was increased from the pilot study to the current study for two reasons. First, the demands placed on the participants have been increased from a total of 6 surveys to 14. Additionally, the self-control measures have been augmented, increasing the length of the survey. Second, the total compensation was increased due to the low response rate of the invitation email used to recruit participants. The low response rate may be a function of how potential participants value their time and that the pilot study's compensation rate did not match their expectations despite past research (Cantor, Cunningham, & Giambo 1998; Kropf, Sheib, & Blair, 2000; Singer, Van Hoewyk, & Maher, 2000).

The age of the participant[21] and whether there is a prepaid component along with the promised compensation can influence response rates; however, these variables have no effect on adults without children (Cantor, Wang, & Abi-Habib, 2003). The increased response rates seen in the past experiments suggests a degree of coercion is influencing the subjects to participate. The current study is designed to remain free of any coercive effects seen in age, monetary compensation, or parental status. The Institute for Women's Policy Research (2014) has found that 26% of college students are raising children that depend on them. There is no intention to measure if participants are raising

[21] It is important to note that the age range that is affected by compensation is 0-17 years old. The current study excludes anyone under the age of 18; therefore, the response rate should not be affected by age or compensation in this study.

children; therefore, the effects of dependent children on participation will not be known. While parental status may pose a problem for response rates the remaining effects of age and monetary reward are easily controlled for in the study.

**Budget**

The maximum payout per participant is $20; therefore, if the study experiences zero attrition and every participant completes every survey the budget for participants will be $3,040.[22] The cost of the SurveySwipe software is $2000 per month; however, QuestionPro agreed to license the software for two months for that price. Additionally, the statistical software to analyze the data cost $275 for a 6 month subscription.

## MEASURES

**Self-control (Attitudinal).** Because the testing of short-term stability of self-control is still in its infancy this was considered an exploratory study. However, this study used tried and tested methods and measures adapted from Grasmick et al., (1993) and the National Longitudinal Study of Youth 97. Grasmick et al.'s (1993) scale was used to measure attitudinal/cognitive levels of self-control throughout the study. During the pilot study the original 24 item measure of self-control were cut down into a more concise 6 item scale. The 6 items chosen in the pilot study were selected based on the length of each question. Shorter questions were used in order to allow participants to

[22] This figure is based on the 127 participants that completed surveys in Arneklev's study with an additional 25 participants to accommodate for attrition. The figure of 25 participants was determined by the 20% attrition rate experienced during the pilot study.

easily read questions on relatively small screens. The rationale for this was to limit the attrition due to an excessively long instrument. Turner and Piquero (2002) had success in using a 6 item attitudinal measure of self-control in their study of self-control stability therefore there was less hesitation moving forward with this construct. However, due to the information gathered during the focus group the attitudinal measures for self-control will be altered and augmented. Participants in the focus group made it clear that slightly longer questions would not affect attrition rates. However, precautions were made not to lengthen the questions too much. Because of the participants' attitudes toward question length, attitudinal self-control measures were chosen based on factor loadings rather than question length. This will hopefully increase validity without negative consequences. Additionally, the focus group indicated that they would not be troubled by answering more questions[23]. In an effort to further increase validity the number of items used to measure attitudinal self-control were doubled to 12 items, two for each element of self-control. Lastly, the nature of the questions was altered in order to be more sensitive to short-term change. It is likely that attitudes a participant has would be unlikely to change from day to day; however, if Grasmick et al. (1993) items were changed in order to reflect attitudes and feelings for that specific day then some change is likely to occur.

The 4-point Likert-type ordinal metrics were used to measure each of the self-control items are: (1) strongly agree, (2) agree somewhat, (3) disagree somewhat, (4) strongly disagree. The Grasmick et al. (1993) scale was used because it has been extensively used to test Gottfredson and Hirschi's version of self-control (Pratt & Cullen,

[23] The focus group indicated that they would feel comfortable with answering up to 20 questions before feeling like the survey was a burden.

2000). Additionally, the Gramick et al. (1993) scale has been tested on its dimensionality, validity, and reliability (Piquero & Rosay, 1998; Vazsonyi et al., 2001; 2003). A precursor statement to the attitudinal items of self-control read, "Answer the following questions with regard to how you feel since the last survey taken". A principal component factor analysis was conducted in order to justify the creation of a single scale for attitudinal self-control. Most of the alphas justify creating a single measure when examined by wave. When the attitudinal self-control items are analyzed collectively across all waves an alpha (.72) is generated that also supports creating a single measure.

**Self-control (Behavioral).** Gottfredson and Hirschi (1990) posit that behavioral measures are preferred over attitudinal measures of self-control. While there has been evidence to show that there is no difference between attitudinal and behavioral measures when it comes to predicting delinquency (Tittle, Ward, & Grasmick, 2003) there is also support for Gottfredson and Hirschi's preference (Evans et al., 1997; Paternoster & Brame, 1997). However, there has been little attention given to the stability of these two self-control constructs with some exceptions (Turner & Piquero, 2002). While attitudes and beliefs may remain constant, the manner in which low self-control manifests itself through behavior may change greatly from day to day. Therefore, measuring these manifestations of low self-control during the study will not only be an unprecedented study of self-control stability but give us an understanding of how self-control varies in

our daily lives through actions free of any socially desired response bias[24]. Building on the work of Turner and Piquero (2002) the current study separated and tested attitudinal and behavioral measures of self-control. However, unlike Turner and Piquero's study where behavioral measures were collected during childhood and attitudinal measures

Table 3.4 Attitudinal Measure of Self-Control

| Items |
|---|
| **IMPULSIVITY** |
| **1.** I think I am going to do what I want tonight rather than wait until later. |
| **2.** I'm more concerned about what's on my schedule tonight than later this week. |
| **SIMPLE TASKS** |
| 3. I feel like being lazy today. |
| 4. I became bored today while doing work. |
| **RISK-TAKING** |
| 5. I feel like taking a risk today just for the fun of it. |
| 6. I feel like I may do something reckless today even if I don't want to. |
| **PHYSICAL ACTIVITIES** |
| 7. I would like to get out and do something today rather than read or contemplate ideas. |
| 8. I would rather do something physical today than something mental. |
| **SELF-CENTEREDNESS** |
| 9. I'm not in the mood to deal with other people today. |
| 10. I need something today and I don't care how people feel until I'm done. |
| **TEMPER** |
| 11. If someone makes me angry today I would rather hurt them than talk to them. |
| 12. If I have a serious disagreement with someone today it may be difficult for me to talk to them without getting upset. |

All Likert items are answered on a 4-point scale of strongly agree (1), agree somewhat (2), disagree somewhat (3), and strongly disagree (4).

[24] Burt et al. (2014) used both attitudinal and behavioral measures of self-control during their stability tests; however, they did not parcel out whether behavioral or attitudinal were more stable than the other.

Table 3.5 Alpha Reliability for Attitudinal Measures

| | | |
|---|---|---|
| Time 1 = 0.43 | Time 5 = 0.66 | Time 9 = 0.78 |
| Time 2 = 0.67 | Time 6 = 0.70 | Time 10 = 0.77 |
| Time 3 = 0.70 | Time 7 = 0.74 | Time 11 = 0.76 |
| Time 4 = 0.73 | Time 8 = 0.75 | Time 12 = 0.73 |

were collected during adolescence the current study collected them simultaneously.

These behavioral response measures of self-control were administered using the smartphone application. The measures consisted of 8 items. Some of these measures are adapted from the Behavioral Problems Index (BPI), a well-validated inventory used in the National Longitudinal Study of Youth (NLSY) (see Zill & Peterson, 1990) and has been used in many prior studies to test self-control (Pratt, Turner, & Piquero, 2004; Raffaelli, Crockett, & Shen, 2005; Turner & Piquero, 2002). However, it was altered in several ways to accommodate the waves. One way that the inventory was altered was through the response options. A 7 point continuous response for each item measuring self-control is: 0 through 6 or more. Another way the inventory was changed was how the question was asked. Instead of asking how true the item is, the respondent was asked how many times they have engaged in the following acts since their last survey. For example, at the beginning of the behavioral self-control section of the survey, before the questions are asked, the survey prompted the participants to answer, "Since the last survey, how many times did you…". Additional items have come from behavioral self-control measures adapted from Tittle et al. (2003) or have been created by the author for

the specific purpose of the current study. If the subject indicated that they consumed alcohol since the last survey they completed the survey software will proceed to the question, "Get drunk". The 'Get drunk' measure will have a 4 point ordinal scale: (1) Not at all, (2) Buzzed, (3) Fairly Drunk, (4) Blacked out[25]. If the subject indicated that they did not consume alcohol since the last survey they completed then the skip logic built into the software will automatically skip the 'Get drunk' question and proceed to the next item. These items remained identical to the behavioral items used in the pilot study to measure self-control because they are more sensitive to daily change than the attitudinal measures used in the pilot study. People are likely to use alcohol as a coping mechanism for stress (Cooper et al., 1992); however, alcohol does not fully mediate stress (Park, Armeli, & Tennen, 2004) allowing for additional manifestations of low self-control to occur. While Laurent, Catanzaro, and Callan (1997) found a significant association between older college students and using alcohol as a coping mechanism, the current study found no such associate between education level or age and self-control or alcohol consumption. Additionally, many people have quit smoking in the general population (Jamal et al., 2015); however, a significant minority still use tobacco products while they drink or when they are out with friends (Mckee et al., 2004). Because it was hypothesized that self-control would decline by the end of the week it would also make sense that students would be more likely to skip classes, arrive late to classes, and have difficulty paying attention toward the end of the week.

[25] This item was dropped when creating the composite measure for crime.

A principal component analysis was conducted to determine if making a composite measure for behavioral self-control was justified. However, many Cronbach alphas did not reach the suggested cut off of .7[26]. However, Nunnally (1978) indicated that a Cronbach's alpha that falls below .7 may be appropriate depending on how the measure is being used and the stage of development of the measure. Cronbach alpha's that fall below .7 are acceptable if an exploratory study is testing new measures (Loewenthal, 2004; Nunnally, 1978). The current study falls under the category of an exploratory study and some of the behavioral measures used have never been used to measure self-control in any capacity. Furthermore, the items used to measure attitudinal and behavioral self-control created the construct of self-control and do not predict self-control. This being the case, these measures do not require the degree internal consistency as other measures (Bollen, 1984). If the items were used to predict self-control then the measures would be guilty of the tautology Akers (1991) warned against.

Table 3.6 Behavioral Measures of Self-Control

| Item |
|---|
| 1. Drink alcohol |
| a. Get drunk |
| 2. Use tobacco products |
| 3. Skip class |
| 4. Cheat or tell lies |
| 5. Not wear a seatbelt |
| 6. Arrived late to class |
| 7. Have difficulty concentrating or paying attention |
| 8. Act cruel to others |

All continuous items (except 'Get drunk') are answered on a 7 point scale of 0, 1, 2, 3, 4, 5, 6 or more.

[26] The cumulative Cronbach alpha for behavioral self-control across all waves was .66.

A principal component analysis determined an overall composite of self-control using standardized behavioral and attitudinal measures was justified (.73[27]). To clarify, The behavioral and attitudinal measures were standardized separately. Next, they were added together, and the additive measure was standardized to create the final composite measure.

Table 3.7 Alpha Reliability for Behavioral Measures

| | | |
|---|---|---|
| Time 1 = 0.74 | Time 5 = 0.60 | Time 9 = 0.66 |
| Time 2 = 0.59 | Time 6 = 0.69 | Time 10 = 0.61 |
| Time 3 = 0.67 | Time 7 = 0.78 | Time 11 = 0.69 |
| Time 4 = 0.71 | Time 8 = 0.86 | Time 12 = 0.52 |

**Crime Involvement.** The link between low self-control and crime has been well established (Pratt & Cullen, 2000). Crime measures were included in the current study to ensure self-control measures effectively predict crime measures in the form of a validity check. The current study will use 6 measures of delinquency derived from the NLSY[28] but will be referred to as "crime" measures instead of "delinquency" because the participants in the current study are adults and by definition cannot engage in delinquency. The 15 crime measures will be dichotomous (1 = yes, 0 = no) and will be assessed at the end of the study. The 15 measures were responses of, "In the past month, have your ever…". Time duration is the only difference between these measures and

[27] This is the Cronbach alpha across all waves of data
[28] Crime measures 2-7 were derived from the NLSY.

NLSY measure of delinquency. These measures of crime have been altered from the measures used in the pilot study much like the attitudinal self-control measures. Nine crime measures were either added or changed in order to capture more varied criminal activity college students would be more likely to engage in. Item 1 and items 8-15 were either created by the researcher or were adapted from LaGrange and Silverman (1999). Additionally, the Crime Involvement survey will not be labeled "Crime Involvement" like the delinquency survey in the pilot study. Instead, the survey will simply be labeled "Activities" in order not to prime the participants in any way.

**Time.** Time is at the very heart of testing stability. Age has commonly been used to mark time in past studies (Burt et al., 2014; Hay & Forrest, 2006; Turner & Piquero, 2002). age measured in years is common for most. However, the current study took place over the course of one month instead of a period of years; therefore, using age in terms of years was not a viable variable. In the pilot study, surveys were administered randomly; however, in the current study surveys were administered systematically. Surveys were administered every Monday, Wednesday, and Friday at 3pm. The first wave was coded as 1, and 2 for the first follow-up, and so on until 12 waves were collected 26 days from the distribution of the first survey.

Following a coding strategy implemented by Barnes et al. (2016), a sensitivity test along with an alternative wave code was used. Although most waves had only 48 hours between each wave, waves from Friday to Monday experienced a 72 lapse in activity. Because the time between each wave was not always equal each wave was recoded to reflect which day the project was on when the surveys were administered. The first

surveys were administered on a Wednesday and were coded as 0, the second survey went out on Friday and were coded as 2, the third survey was not administered until the following Monday and was subsequently coded as 5 (5 days after data collection began). This coding strategy continued until the last survey was coded as 26. This strategy yielded similar results to Barnes et al. (2016) and did not significantly alter the results of the analysis.

Table 3.8 Measures of Crime Involvement

| Item |
|---|
| 1. Intentionally broken the traffic laws such as speeding, running a stoplight, or driving after drinking |
| 2. Got into a fight at school or work |
| 3. Taken something without paying for it |
| 4. Taken something worth under $50 |
| 5. Taken something worth over $50 |
| 6. Used force to get money from someone |
| 7. Hit or seriously threatened someone |
| 8. Used marijuana |
| 9. Used or attempted to use a credit/debit card without permission |
| 10. Used hard drugs like crack, cocaine, heroin, LSD, or other non- prescription drugs |
| 11. Sold drugs such as crack, heroin, LSD, cocaine |
| 12. Sold prescription drugs |
| 13. Used prescription drugs that were not prescribed to you or used them in a way other than intended |
| 14. Consumed alcohol underage or purchased alcohol for someone underage |
| 15. Sold marijuana |

All dummy items are answered as either Yes (1); No (2)

**Biologics.** Biological influences can theoretically affect an individual's short-term and long-term self-control. Lead in tap water can have behavioral consequences; however, these effects would not become apparent until months or years after constant exposure

(Nevin, 2000). Sleep (Christian & Ellis, 2011) and blood sugar levels (Benton & Parker, 1998) on the other hand may have significant impacts on cognitive functioning after only slight differences in daily routine. Because of the sensitivity of cognitive functioning it is important make sure biological influences are not the reason why self-control is or is not stable.

There were two biological variables in the current study; sleep and blood sugar. Sleep was measured using a dummy variable "got a good night's sleep and/or feel rested" (1= yes and 2 = no). This is more effective than asking how many hours of sleep the participants received because there is inherently too much error in using hours of sleep to gauge its effect on cognitive functioning. People function differently on varying hours of sleep. Some people need very little sleep while other people need 9 or 10 hours of sleep to feel rested and function normally; therefore, using a dichotomous variable in the current study seems to be the most effective.

Glucose has been shown in laboratory experiments to influence self-control levels Gailliot et al., (2007). It is not realistic for the participants to take blood sugar tests every other day for a month to determine glucose levels. To indirectly assess glucose levels participants will be asked to answer, "I have eaten today and/or don't feel hungry" (1 = yes or 2 = no). Glucose levels are measured in much of the same way as sleep for similar reasons. Some people function perfectly well without breakfast or little food, while other people feel they cannot function if they skip a meal or do not eat enough.

**Control Variables**

In addition to the variables above, a number of control variables were included in the analysis including *sex* (1 = male, 0 = female), a nominal variable, *race* (1 = white, 2 = black, 3 = Hispanic, 4 = Asian, 5 = other). *Age* (18-88) will also be controlled for and measured in years. The rationale for this measuring age this way comes from Tittle and his colleagues (2003; 2004) in which they use a range from 18-88. Traditionally, education has been measured by alternative measures (Tittle et al., 2003; 2004); however, this study will have a relatively homogeneous sample in terms of education. Because of the sample's homogeneity education was measured using an ordinal scale from freshman (1) through senior (4). Childhood home intactness comes from the studies by Tittle et al. (2003; 2004) in which they sometimes referred to as "childhood family intactness" or "childhood family structure". The current study used the same operationalization of childhood home intactness as Tittle and colleagues by asking their respondents, ''Think back to when you were growing up: in general, which of the following describes your family situation?'' Most of the time, you were living with (1) only your mother or mother-figure (like a stepmother); (2) only your father or a father- figure (like a stepfather); (3) both your mother (or mother-figure) and father (or father-figure); (4) other. It is understood that many children grow up with only one parent; therefore, the following responses were scored accordingly: ''1'' for ''only father...'' and ''other''[29]; ''2'' for ''only mother…''; ''3'' for both parents, whether biological or surrogate; and "4" for other. Child residence will be in five categories from farm (1) to city (5) to

[29] This coding scheme was first designed by Tittle et al., (2004) and is used here.

determine urbanicity. Child residence will be in five categories (1) farm; (2) in a rural area, but not farm; (3) small town of 10,000 or less *not* located near a bigger city; (4) small town of 10,000 or less located near a bigger city; and (5) city of 10,000 or more. Finally, the current residence is where the student currently lived while attending the university. The current residence variable was measured by asking the respondent to identify whether they lived in on-campus housing (1); off-campus apartment housing (2); off-campus house (3). Once again, these variables are the same measures used in the pilot study to identify demographics and were not changed. These demographic variables were collected only at the beginning of the data collection phase. This was done for two reasons; first, these variables are constants and therefore will not change during the course to the study. Second, decreasing the number of superfluous variables during the smartphone data collection phase were intended to decrease the likelihood of participants dropping out of the study due to such a long survey.

## ANALYTIC STRATEGY

There are three primary research questions in the current study, and they are:

*1. Is self-control relatively stable in the short-term?*

*a. If self-control is not stable what variables contribute to that instability?*

*2. Is there a difference in the stability of behavioral measures of self-control and attitudinal measures of self-control?*

*3. Does the Law of Longitudinal Relationships drive the stability of self-control?*

**The Short-term Stability of Self Control**

Testing short-term stability of self-control is much like testing self-control over longer periods of time. Several different models were necessary but a replication of most of Burt et al.'s (2014) models and Barnes et al.'s (2016) were used. Burt et al., (2014) calculated mean differences, stability coefficients, hierarchical linear models, and group-based trajectory models. Barnes and colleagues (2016) included a Reliable Change Index and the P(Δ) in addition to many of the analyses done by Burt et al., (2014). The current study was designed to be exhaustive and used a varies of analyses to account for different weaknesses apparent in each of these analyses.

Mean differences were the first analyses conducted in the current study. While testing mean-level changes is an important first step in the analysis allowing for the observation of absolute level differences between waves, it does have its disadvantages. One disadvantage is the inability to determine relative changes or the source of those changes. Additionally, the analysis of means provides no parameter estimate and therefore does not provide way to statistically infer how much change has occurred. However, these drawbacks are accounted for in other analyses in the study.

The Spearman rank-order correlation is the logical next step when analyzing stability. Spearman rank-order correlation compare the changes between individuals within the dataset making it advantageous for analyzing relative stability. However, like the mean comparison analysis the Spearman rank-order correlation has a major shortcoming. The Spearman rank-order correlations can only be used for two variable combinations. Therefore, there is no parameter estimate that can summarize reliable change in a longitudinal dataset because the Spearman rank-order correlation can only

account for change between two data points. While statistics like Spearman's rank-order correlation are advantageous, giving multiple opportunities to witness change, it limits observation and analysis to a myopic view of the dataset. Once again, other analyses were used to account for this weakness.

The current study used a Reliable Change Index to measure stability between waves. The Reliable Change index is a statistic that provides a measure for both clinical and statistical significance by taking scale reliability into account (Jacobson et al., 1999). More commonly used in the psychological field, the Reliable Change Index which was reintroduced[30] by Jacobson, Follette, and Revenstorf (1984) and later revised by Christensen and Mendoza (1986). The Reliable Change Index was developed to identify reliable change in clinical studies. The concept of "reliable change" is derived from the concept of "clinical significance". Clinical significance refers to significance of within individual change as opposed to relying on effect sizes from a group perspective. For instance, a minority of participants may drastically improve over time subsequently improving the mean; however, the majority of the sample may experience no change or even regress (Smith, Glass, & Miller, 1980). The word "reliable" is used to describe the change because the analysis takes the reliability of the measure into consideration when calculating the statistic (Zahra & Hedge, 2010).

The Reliable Change Index (RCI) score is a standardized statistic with values that are directly proportional to each other. For instance, if participant "A" scored an RCI of 2

[30] This kind of statistic was developed years earlier (Lord & Novick, 1968; McNemar, 1962) but started to become more widely used when it was reintroduced (Maassen, 2004).

and participant "B" scored an RCI of 1, participant "A" experienced twice as much positive change as participant "B". Positive RCI scores indicate an increase or positive change while negative scores indicate a decrease or negative change.

The Reliable Change Index can be statistically applied to the relative stability of self-control by using part of Jacobson et al's., (1984) logic: The RCI score must exceed ±1.96 to be considered statistically significant at the $p<.05$ level (Jacobson & Truax, 1991). An RCI score of zero between any two time points indicates no change for a specific individual. If the RCI score (amount of change) falls short of 1.96 or does not drop below -1.96 from one wave to another than the individual's RCI score (change) is considered unreliable and statistically insignificant. Any RCI score that falls within the ±1.96 bounds can most likely be attributed to normal variation within the individual or measurement error (Zahra & Hedge, 2010). Participants who fall within the 1.96 bounds are not considered outliers. The Reliable Change Index Score is calculated with following equation:

$$RCI = \frac{y_{ij} - y_{ij-1}}{\sqrt{SEM_j^2 + SEM_{j-1}^2}}.$$

The numerator is the difference between the individual's($i$) self-control measure($y$) at time($j$) and the previous time point. In other words, the numerator is a pretest and posttest or the difference in self-control scores between a preceding or subsequent wave. The denominator is the sum of the squared standard error of measurement for time($j$) and the squared standard error of measurement for time ($j$ -1*)*. The standard error of measurement (SEM) is the standard deviation of errors of measurement that are

associated with the test scores from a particular group of examinees (Harvill, 1991). In other words, the standard error of measurement is how observed scores are distributed around the "true" score of a particular trait. However, the "true" score can never be known because no instrument is perfect. Therefore, it takes test reliability into consideration by providing the dispersion of measurement error in order to identify what the "true" score of a trait might be. The square root of the summed standard error of measurements is then calculated to attain an adjusted standard deviation unit. The squared standard error for (*j*) is calculated with the following equation (Agresti & Franklin, 2016):

$$SEM_j^2 = \left(s_j\sqrt{1 - a_j}\right)^2$$

Where $s_j$ is the standard deviation of self-control for that specific wave and $a_j$ is the Cronbach alpha for that particular wave's measure for self-control. An adjusted *z*-score is created when the numerator is divided by the adjusted standard deviation unit.

Using the Reliable Change Index is a valuable tool for identifying meaningful change within individuals and helps prevent against overfitting models, which is a danger when estimating group-based trajectory models. The Reliable Change Index has an advantage over the Spearman rank-order change because it can handle identical scores between two or more individuals in a particular wave[31]. However, the Reliable Change Index suffers from the same weakness as the Spearman rank-order correlation in one

[31] Kendall's Tau is a viable substitute to Spearman's rank-order correlation in this situation if no other alternatives exist. However, identifying which subjects experienced change or the direction of that change is still difficult when using a statistic like Kendall's Tau.

critical respect. Only two data points can be analyzed at any given time; therefore, calculating a parameter estimate to estimate change over more than two waves becomes impossible.

The second series of models were hierarchical linear models (HLM) of low self-control. This analysis allowed for the testing of two propositions of stability; absolute and relative. HLM allows for the ability to test within-individual change and between-individual change. Additionally, once divided into groups using GBTM, HLM analyses will be conducted using groups in addition to individuals. One of the benefits of using multilevel modeling in a longitudinal study is that the times of wave completion are allowed to vary from respondent to respondent (Stevens, 2007). This is important because not all of the participants cannot be expected to complete the smartphone surveys at the exact same moment. Additionally, surveys do not need to be completed on every occasion in order to achieve valid results (Stevens, 2007). Nevertheless, HLMs or other multilevel models for change can suffer from overfitting.

The third series of models used group-based trajectory modeling (GBTM) to identify different group trajectories (Jones, Nagin, & Roeder, 2001; Nagin, 2005) of self-control. While these groups are not meant to identify separate taxonomies, they do provide insight on how individual and group trajectories change over time (Nagin & Odgers, 2010). If these trajectories change in different ways it is valuable for providing evidence for relative instability within the sample. How many groups were included in the study were determined by using the Bayesian Information Criterion (BIC) (Nagin, 2005) as well as observing the qualitative differences between group trajectories. However, like multilevel models for change, these models can suffer from overfitting.

The final model estimated the P(Δ) outlined by Barnes et al. (2017). Using the rank-order logic of the Spearman coefficient, RCI, and a Monte Carlo simulation to randomly choose pairs of individuals P(Δ) provides a parameter estimate to directly identify the probability that an individual's rank will change within the dataset. P(Δ) can be estimated by using the formula:

$$\mathrm{P}(\Delta) = \frac{\sum_{t=1}^{T} RankChange_t}{T},$$

$$where: RankChange_t = \begin{cases} 0 & \text{if stability or no rank order change has occured} \\ 1 & \text{if reliable change is observed and rankings change'} \end{cases}$$

and (T) is the total number of trials(*t*). Therefore, the number of reliable and rank-order changes is divided by the total number of trials or iterations to calculate the P(Δ) statistic. Ideally, the number of trials would equal the total number of unique combinations possible in the dataset; however, this may be difficult with very large datasets.

**The Differences Between Attitudinal and Behavioral Measures of Self-Control Stability**

Testing the difference between attitudinal measures and behavioral measures of self-control has been tested in the past (Evans et al., 1997; Paternoster & Brame, 1997; Tittle et al., 2003). However, how these two constructs differ in terms of their stability has yet to be fully explored. The process by which to test these constructs is similar to testing the overall concept of self-control, whether it is in the short or long-term. The first model will use stability correlation coefficients of both attitudinal measures and behavioral measures as well as differences observed between the Reliable Change Index scores.

The second series of models used the HLM analyses for attitudinal and behavioral measures of self-control. The HLMs was used to achieve the same objective as testing short-term stability. The HLM allowed for the within-group and between-group variation of attitudinal and behavioral self-control to be address. Finally, P(Δ) was estimated and the results of these were compared to identify any noticeable differences.

**The Law of Longitudinal Relationships and Self-Control**

The law of longitudinal relationships suggests the longer the interval between measurement waves, the lower the correlation (Moffitt, 1993). Cross-year correlations are typically high, usually above .6 or .7; however, correlations between lengthy periods tend to drop considerably (Alwin, 1994). The current study used days instead of years. Correlation coefficients were used to determine if the length of time between surveys is associated with the stability of self-control. It was important to statistically control for age, education, and other variables that may affect the stability of self-control. While many variables may account for the stability, or instability of self-control (Hay & Meldrum, 2015) the law of longitudinal relationships is a concept that has yet to be proposed or tested.

An additional analysis was conducted to more accurately determine if the correlations have an impact on the stability of low self-control. Using the estimations and their standard deviations from pairwise correlations and a Reliable Change Index 2000 observations were created and regressed against each other.

# CHAPTER 4

# RESULTS

## THE SHORT-TERM STABILITY OF SELF-CONTROL

### Mean-Level Changes and Spearman Rank-Order Correlations

Table 4.1 details some descriptive statistics as well as a pairwise correlation between waves. It is easily observable that the means and standard deviations show little change between waves indicating stability. In addition to the observable indicators of stability, all correlations were statistically significant. Despite this, an observable increase in the self-control scale that indicated participants improved their self-control over time. This reaffirms the original theory proposed by Gottfredson and Hirschi (1990) that self-control may increase due to the natural aging of the organism; however, this increase may not be due to a genuine increase in self-control and instead be the result of some methodological phenomenon. Regardless, an increase in self-control in previous studies have been observed over time (Barnes et al., 2016). Additionally, these findings do not identify the source of these changes which is why it is critical to use an analysis such as Spearman rank-order correlation to help resolve these issues.

As seen in Table 4.2, the Spearman rank-order correlations are not the best but do get stronger after wave 4. If a Spearman rank-order correlation was 0 it would indicate absolute instability between waves. On the contrary, if a Spearman rank-order correlation were exactly 1 then the correlation would indicate perfect relative stability between waves of self-control. While some of the correlations in Table 4.1 fall close to

.50 (a value that could not give support for or against relative stability), there are no values that fall below this number in the entire table. Furthermore, some correlations reach .70 which demonstrates relative stability between waves. Yet, this may be due to the short wavelengths so the results should be interpreted with caution.

**Reliable Change Index (RCI)**

The Reliable Change Index makes it possible to identify whether the relative change between waves is due a reliable change or it is due to error. These changes can be observed in the box-and-whisker plot, Figure 4.1 as well as Table 4.3 which show the RCI scores for an increase, decrease, or any change in self-control. Each of the box-and-whiskers represents the RCI scores between waves. All RCI scores that fall outside the ±1.96 bounds, represented by the red lines, are individual subjects who experienced reliable change. The first box illustrates the changes that occurred between the first and second waves, the second box-and-whisker illustrates the changes that occurred between the third and second waves, and so on until the last box, on the far right, which represents the changes that occurred between waves 12 and 11.

Two things become clear after viewing Figure 4.1 as well as Table 4.3. First, the medians of each of the boxes are all relatively close to 0 on the plot indicating that not much change has occurred between waves. Table 4.3 shows the percentage of the sample that experienced change. The percentage of the sample that experience an in self-control is more prominent than the proportion of the sample that experienced a decrease in the same examination of waves. This indicates that with every wave, subjects are more likely to increase their level of self-control than decrease. A prominent example of this

can be seen between wave 3 and wave 2. 5.45% of the sample experienced an increase in self-control whereas there was only 1.21% of the sample experienced a decrease during that same wavelength.

However, the uniqueness of 3 prominent reversals are extremely important to note. Each of these reversals occurred between waves of data that were collected on Wednesday and Friday. This indicates that individuals are more likely to experience a decrease in self-control from Wednesday afternoon through Friday morning. This partially supports a hypothesis that self-control deteriorates throughout the week and then resets over the weekend. Specific dates and events could also alter levels of self-control. For instance, Hurricane Irma struck the southeastern coast of the United States causing classes to be cancelled. The hurricane struck during the first three waves of data collection. Self-control during the first three waves was significantly lower than any other time during the study. Future studies may find value in studying the sensitivity of self-control when events such as a hurricane occur.

**Multilevel Model for Change (MMC)**

Multilevel models or hierarchical models is one way to help determine stability within and between individuals. Table 4.4 depicts three separate multilevel models. The first model, "Unconditional means model", which can be seen in the first two columns of

**Table 4.1** Descriptive statistics and correlations

| Variable | Mean | St. Deviation | Cronbach's alpha | Wave-to-wave pairwise correlations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
| Self-Control$_{w1}$ | -0.33 | 0.88 | 0.62 | - | | | | | | | | | | | |
| Self-Control$_{w2}$ | -0.27 | 0.90 | 0.53 | 0.68 | - | | | | | | | | | | |
| Self-Control$_{w3}$ | 0.01 | 0.86 | 0.61 | 0.50 | 0.54 | - | | | | | | | | | |
| Self-Control$_{w4}$ | 0.16 | 0.9 | 0.61 | 0.49 | 0.53 | 0.62 | - | | | | | | | | |
| Self-Control$_{w5}$ | -0.03 | 0.88 | 0.63 | 0.51 | 0.56 | 0.61 | 0.67 | - | | | | | | | |
| Self-Control$_{w6}$ | 0.20 | 0.84 | 0.62 | 0.50 | 0.47 | 0.60 | 0.62 | 0.60 | - | | | | | | |
| Self-Control$_{w7}$ | 0.20 | 0.92 | 0.67 | 0.44 | 0.49 | 0.60 | 0.59 | 0.56 | 0.66 | - | | | | | |
| Self-Control$_{w8}$ | 0.01 | 1.08 | 0.77 | 0.44 | 0.47 | 0.44 | 0.46 | 0.52 | 0.54 | 0.57 | - | | | | |
| Self-Control$_{w9}$ | 0.23 | 0.97 | 0.66 | 0.53 | 0.54 | 0.54 | 0.59 | 0.67 | 0.68 | 0.72 | 0.61 | - | | | |
| Self-Control$_{w10}$ | 0.16 | 0.94 | 0.61 | 0.50 | 0.51 | 0.62 | 0.54 | 0.62 | 0.62 | 0.59 | 0.56 | 0.70 | - | | |
| Self-Control$_{w11}$ | 0.00 | 0.99 | 0.67 | 0.42 | 0.45 | 0.53 | 0.47 | 0.52 | 0.62 | 0.58 | 0.62 | 0.66 | 0.62 | - | |
| Self-Control$_{w12}$ | 0.17 | 0.96 | 0.53 | 0.40 | 0.42 | 0.64 | 0.49 | 0.59 | 0.55 | 0.57 | 0.57 | 0.62 | 0.74 | 0.65 | - |

*Self-Control has been standardized* (All correlations are statistically significant at the .05 level)

St. Deviation = standard deviation; Cronbach's alpha = reliability coefficient

**Table 4.2** Stability correlations

| Variable | Wave-to-wave Spearman rank-order correlations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
| Self-Control$_{w1}$ | - | | | | | | | | | | | |
| Self-Control$_{w2}$ | 0.70 | - | | | | | | | | | | |
| Self-Control$_{w3}$ | 0.53 | 0.57 | - | | | | | | | | | |
| Self-Control$_{w4}$ | 0.53 | 0.55 | 0.56 | - | | | | | | | | |
| Self-Control$_{w5}$ | 0.52 | 0.55 | 0.58 | 0.68 | - | | | | | | | |
| Self-Control$_{w6}$ | 0.55 | 0.49 | 0.50 | 0.60 | 0.60 | - | | | | | | |
| Self-Control$_{w7}$ | 0.48 | 0.52 | 0.56 | 0.62 | 0.57 | 0.61 | - | | | | | |
| Self-Control$_{w8}$ | 0.42 | 0.50 | 0.44 | 0.47 | 0.56 | 0.55 | 0.64 | - | | | | |
| Self-Control$_{w9}$ | 0.55 | 0.55 | 0.46 | 0.56 | 0.65 | 0.62 | 0.68 | 0.61 | - | | | |
| Self-Control$_{w10}$ | 0.56 | 0.55 | 0.55 | 0.54 | 0.61 | 0.61 | 0.62 | 0.58 | 0.67 | - | | |
| Self-Control$_{w11}$ | 0.55 | 0.51 | 0.52 | 0.48 | 0.59 | 0.54 | 0.63 | 0.64 | 0.65 | 0.64 | - | |
| Self-Control$_{w12}$ | 0.49 | 0.49 | 0.58 | 0.54 | 0.61 | 0.56 | 0.62 | 0.65 | 0.67 | 0.67 | 0.70 | - |

St. Deviation = standard deviation; Cronbach's alpha = reliability coefficient

(All correlations are statistically significant at the .05 level)

Table 4.3 Reliable Change Index (RCI)[32]

| | Percentage Increase | Percentage Decrease | Any Percentage of Change |
|---|---|---|---|
| RCI w2-w1 | 1.82(3) | 1.21(2) | 3.03(4) |
| RCI w3-w2 | 5.45(9) | 1.21(2) | 6.66(11) |
| RCI w4-w3 | 4.24(7) | 1.82(3) | 6.06(10) |
| RCI w5-w4 | 0.60(1) | 2.42(4) | 3.03(5) |
| RCI w6-w5 | 4.24(7) | 1.82(3) | 6.06(10) |
| RCI w7-w6 | 1.82(3) | 1.82(3) | 3.64(6) |
| RCI w8-w7 | 1.82(3) | 6.06(10) | 7.87(13) |
| RCI w9-w8 | 6.66(11) | 2.42(4) | 9.09(15) |
| RCI w10-w9 | 1.82(3) | 3.03(5) | 4.84(8) |
| RCI w11-w10 | 2.42(4) | 5.45(9) | 7.87(13) |
| RCI w12-w11 | 3.63(6) | 1.82(3) | 5.45(9) |

*Numbers in parentheses reflect the raw number of participants experiencing change*

Sample size for each wave = 165

the table. Although this model does not give much information, the average level of self-control across the entire sample space is given. There were no waves entered into this model so the constant provides a baseline level of self-control (.37). The majority of self-control scores ranged from .36-.38 because the standard deviation was .01. In order to estimate within-individual change additional models must be run with waves in order to account for time.

[32] A sensitivity analysis was conducted to make sure analyzing RCI scores from participants who completed all waves did not differ from those who dropped out. This analysis slightly decreased the total percentage of participants experiencing change but did show that the dropouts were more likely to have reliable decreases in self-control.

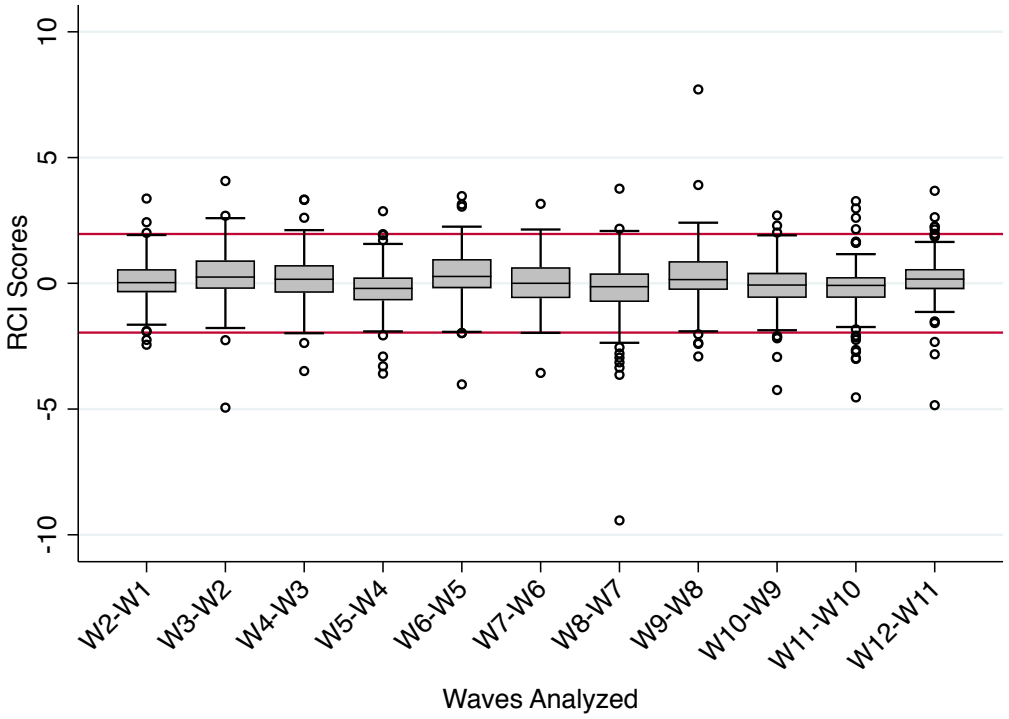



Figure 4.1 Reliable Change Index (RCI) Scores for Each Wave

The second model in Table 4.4 is labeled "Unconditional linear growth model". This model takes into account the linear effects of time on self-control. Although the intercept has changed from the unconditional means model it has not changed by much. The new intercept estimates the baseline level of self-control for all participants in the study. As the table indicates, each wave of data saw an increase in self-control of .01 with each wave. This is an unimpressive change but still statistically significant.

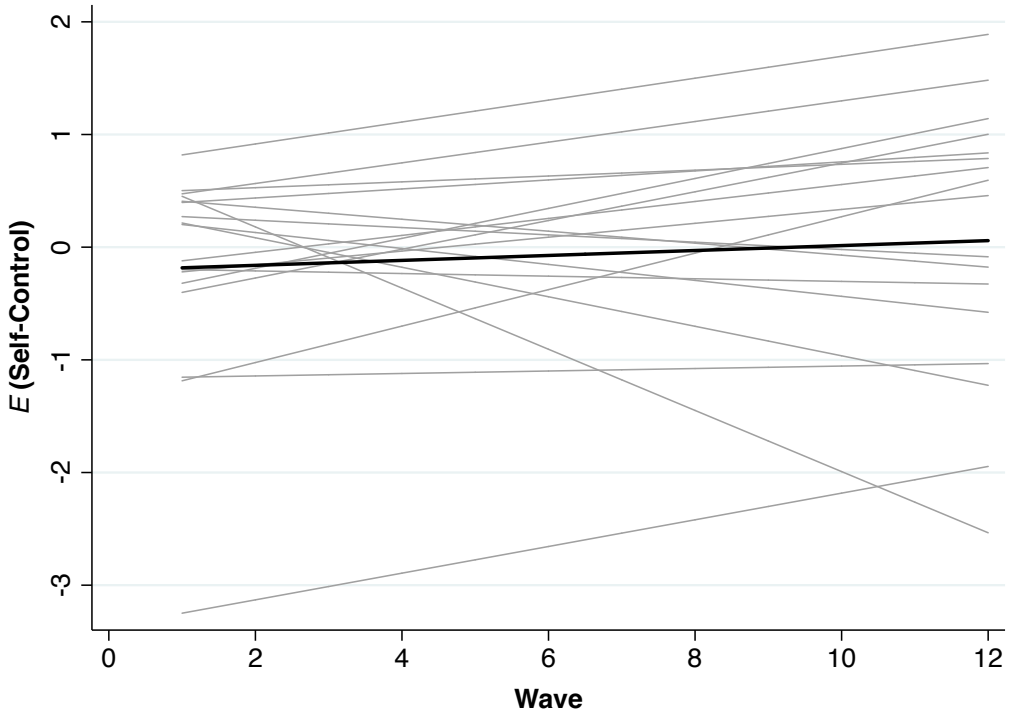



Figure 4.2 Expected Values of Self-Control as a Function of Time

This limited "growth" indicates that the majority of the sample exhibited limited change in self-control. To help visualize these results please refer to Figure 4.2. This figure represents the linear growth of 10% of the sample that were randomly selected. While there are several cases that demonstrate significant decreases in self-control throughout the duration of the study many cases follow the trend line fairly well. When control variables were introduced in this model they did not change the significance of time. These results can be seen in the table presented in Appendix: E.

**Table 4.4** Multilevel models for change (MMC) in self-control

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | SE | *b* | SE | *b* | SE |
| Intercept, $\gamma_{00}$ | .37* | 0.01 | .30* | 0.01 | .22* | 0.01 |
| Wave, $\gamma_{10}$ | - | - | .01* | 0.00 | .04* | 0.00 |
| Wave$^2$, $\gamma_{20}$ | - | - | - | - | -.00* | 0.00 |
| Random effects | St. Dev. | SE | St. Dev. | SE | St. Dev. | SE |
| Random variance in Intercept, $\sigma_0$ | 0.24 | 0.01 | 0.23 | 0.01 | 0.24 | 0.01 |
| Random variance in Wave, $\sigma_1$ | - | - | 0.01 | 0.36 | 0.04 | 0.00 |
| Random variance in Wave$^2$, $\sigma_2$ | - | - | - | - | 0.00 | 0.00 |
| Level 1 error variance, $\sigma_\varepsilon$ | 0.57 | 0.02 | 0.58 | 0.02 | 0.61 | 0.03 |
| *Rho*, $\rho$ | 0.57 | | 0.58 | | 0.62 | |
| *ln*(*likelihood*)[*df*] | 22.09[3] | | 104.96[6] | | 139.84[10] | |
| *AIC* | -38.19 | | -197.92 | | -259.68 | |
| *BIC* | -20.52 | | -162.58 | | -200.78 | |

*b* = Unstandardized parameter estimate; St. Error = standard error; St. Dev = standard deviation

* $p < .05$ (two-tailed tests)

sample size = 165

total observations = 1980

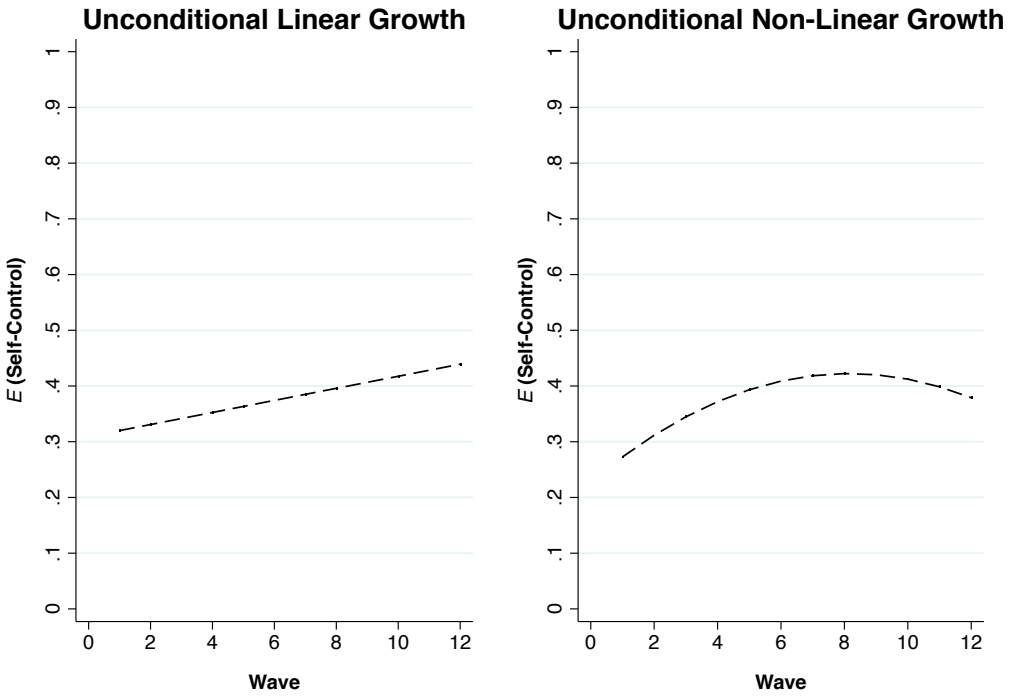



Figure 4.3 Unconditional Linear and Non-Linear Growth Multilevel Models for Change

While incept intercept only model provided a much better fit for the data than the unconditional linear growth model it is important to determine if time has a non-linear effect. The quadratic model, identified as the "Unconditional non-linear growth" model, can be found in the last two columns of Table 4.4. While it appears that self-control is decreasing by an average of -.00 with each wave of data collection this may be misleading and difficult to visualize. The quadratic effects can be seen in figure 4.3 where there is fairly continuous increase in self-control followed only by a short decrease in the final waves of the study. It can be determined that this nonlinear effect is largely due to the unusually low levels of self-control witnessed during the weather caused by Hurricane Irma. Regardless of what caused the non-linear effects the quadratic model

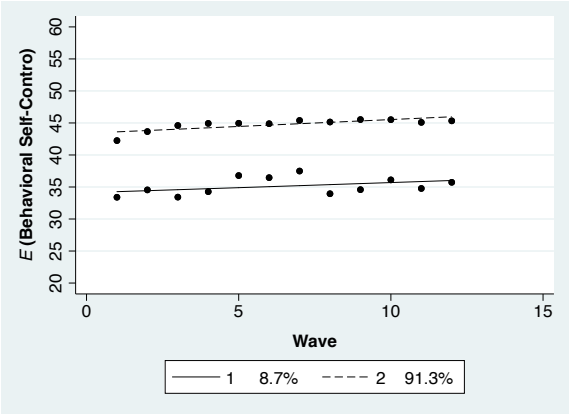
provides a better fit for the data than the means model or the linear growth model and it is statistically significant. Additionally, much like the linear model, control variables were introduced to determine if they had any significant impact on the stability of self-control. The table in Appendix: E, illustrates these control variables did not change the significance of time in the between and within-group analyses. Furthermore, the *rho* for each model, .57, .58, and .61 provide moderate support for relative stability.

**Group-Based Trajectory Model (GBTM)**

Separate group-based trajectory models were estimated for attitudinal self-control and behavioral self-control. Separate models were estimated because the composite measure for self-control did not estimate properly. Regardless, valuable information pertaining to stability can be gleaned by looking at Tables 4.5 and 4.6, as well as Figures 4.4 and 4.5 simultaneously. Table 4.5 and Table 4.6 display the models in the columns with parameters and fit statistics in the rows.

The functional forms of the wave parameter were tested first. This was done by estimating an intercept only model first and then estimating subsequent models for linear and quadratic effects. Attitudinal self-control showed minimal change between any of these estimations and behavioral self-control showed a noticeable but still small improvement in fit between the intercept only and linear or quadratic models. The second set of models were the two group models. The linear models in this column are bolded because this was determined to be the best fitting models. Notice that the fit statistics for the more complex models garner better *BICs* and *AICs*; however, there is the real possibility of over fitting the model. While each additional model's parameters are

significant, the incremental increase in model fit did not justify using a more complex model (Nagin, 2005).



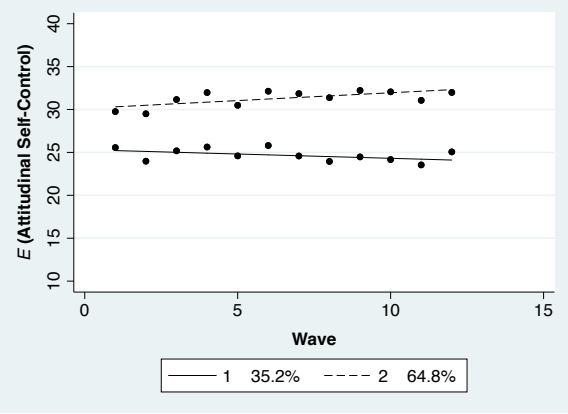




Figure 4.4 (left) Two Group Linear Estimation for Group-Based Trajectory Model for Behavioral Self-Control

Figure 4.5 (right) Two Group Linear Estimation for Group-Based Trajectory Model for Attitudinal Self-Control

Interpreting the group-based trajectory model is fairly straight forward and is similar to other outputs. The two-group behavioral measure shows the intercept of group one to be 25.31 and the intercept of group two to be 30.12. What is interesting are the slopes associated with these two groups. The slope for group one is dissimilar to the slopes found in other models estimated in the current study, boasting a -.10 increase in self-control for each wave in the study. Group two shows a positive growth in self-control .18 for each wave in the study. This can be seen graphically in Figure 4.5. This would appear to indicate an intersection of group trajectories in the past; however, this cannot be said with certainty and the slopes are not enough to determine instability. The linear slopes for the behavioral measure are nearly identical (group 1 = .00; group 2 = .00) showing almost perfect relative stability which can be seen in Figure 4.4.

**Table 4.5** Group-based trajectory model (GBTM) for attitudinal self-control parameter estimates and fit statistics

| Parameters and fit statistics | One group model | Two group model | | Three group model | | |
|---|---|---|---|---|---|---|
| | Group 1 | Group 1 | Group 2 | Group 1 | Group 2 | Group 3 |
| **Intercept only** | | | | | | |
| Intercept | 28.94* | 24.74* | 31.39* | 23.94* | 30.11* | 35.87* |
| *ln(likelihood)* | 8269.25 | 7877.52 | | -7757.31 | | |
| *BIC* | -8274.83 | -7888.69 | | -7774.06 | | |
| *AIC* | -8271.25 | -7881.52 | | -7763.31 | | |
| Group (%) | 100 | 35.95 | 64.04 | 27.64 | 63.62 | 8.73 |
| **Linear fit** | | | | | | |
| Intercept | 28.35* | **25.31** | **30.12** | 24.84* | 29.17* | 33.72* |
| Linear | 0.09* | **-0.10*** | **0.18*** | -0.15* | 0.14* | 0.33* |
| *ln(likelihood)* | 8264.57 | **-7859.83** | | -7734.06 | | |
| *BIC* | -8272.95 | **-7876.58** | | -7759.19 | | |
| *AIC* | -8267.58 | **-7865.83** | | -7743.06 | | |
| Group (%) | 100 | **35.20** | **64.79** | 27.29 | 63.29 | 9.41 |
| **Quadratic fit** | | | | | | |
| Intercept | 27.67* | 25.26* | 28.96* | 24.85* | 28.09* | 32.15* |
| Linear | .39* | -0.08 | 0.69* | -0.17 | 0.58* | 0.94* |
| Quadtratic | -0.02* | 0.00 | -0.04* | 0.00 | -0.03* | -0.05 |
| *ln(likelihood)* | 8261.82 | -7852.25 | | -7725.83 | | |
| *BIC* | -8273.00 | -7874.59 | | -7759.33 | | |
| *AIC* | -8265.83 | -7860.25 | | -7737.83 | | |
| Group (%) | 100 | 34.98 | 65.01 | 26.66 | 62.74 | 10.59 |

Best-fitting model in bold Sample size = 266

* $p < .05$ (two-tailed tests) Number of observations = 2671

**Table 4.6** Group-based trajectory model (GBTM) for behavioral self-control parameter estimates and fit statistics

| Parameters and fit statistics | One group model | Two group model | | Three group model | | |
|---|---|---|---|---|---|---|
| | Group 1 | Group 1 | Group 2 | Group 1 | Group 2 | Group 3 |
| **Intercept only** | | | | | | |
| Intercept | 3.78* | 3.55* | 3.80* | 3.42* | 3.63* | 3.80* |
| *ln(likelihood)* | 8309.76 | 8143.13 | | 8127.59 | | |
| *BIC* | -8312.56 | -8151.51 | | -8141.56 | | |
| *AIC* | -8310.77 | -8143.14 | | -8132 | | |
| Group (%) | 100 | 8.75 | 91.24 | 2.33 | 9.87 | 87.79 |
| **Linear fit** | | | | | | |
| Intercept | 3.75* | **3.52*** | **3.77*** | 3.41* | 3.59* | 3.77* |
| Linear | 0.00* | **0.00** | **0.00*** | 0.00 | 0.00 | 0.00* |
| *ln(likelihood)* | 8292.27 | **8127.71** | | -8111.45 | | |
| *BIC* | -8297.85 | **-8141.68** | | -8133.79 | | |
| *AIC* | -8294.27 | **-8132.72** | | -8119.45 | | |
| Group (%) | 100 | **8.68** | **91.31** | 2.44 | 10.25 | 87.29 |
| **Quadratic fit** | | | | | | |
| Intercept | 3.72* | 3.48* | 3.73* | 3.41* | 3.52* | 3.77* |
| Linear | 0.01* | 0.02 | 0.01* | 0.00 | 0.03* | 0.01* |
| Quadtratic | -0.00* | 0.00 | 0.00* | 0.00 | -0.00* | -0.00* |
| *ln(likelihood)* | 8285.23 | 8119.55 | | -8103.12 | | |
| *BIC* | -8293.61 | -8139.09 | | -8133.84 | | |
| *AIC* | -8288.23 | -812655 | | -8114.13 | | |
| Group (%) | 100 | 8.62 | 91.37 | 2.32 | 10.35 | 87.31 |

Best-fitting model in bold Sample size = 266

* $p < .05$ (two-tailed tests) Number of observations = 2671

This being the case, it is a sign of overfit. If the outputs differ only quantitatively and not qualitatively and show not substantive change between model estimation it is indicative of over fit (Skardhamar, 2010). In summation, the group-based trajectory models provide evidence for a substantial amount of relative stability within the sample.

**P(Δ)**

As stated above, none of the previous analyses actually address the question many researchers try to answer; what is the probability that individual's ranking will change? Pdelta or P(Δ) uses the RCI to determine whether individual changes were reliable. Then P(Δ) uses a Monte Carlo simulation to randomly draw case pairs of these reliable changes and identifies if the ranks have changed during any of the waves. 1-P(Δ) gives the probability of relative stability between any two cases drawn from the dataset.

The current study used the same P(Δ) analysis as Barnes et al., (2016). Only complete cases were used during the analysis of the current study which nearly cut the sample in half ($n$ = 165). Because there are 13,530 possible unique combinations of cases the Monte Carlo was set to 13,530 iterations. The current study's dataset is relatively small; however, studies using larger datasets can still use fewer iterations to obtain valid. Fewer iterations (10,000) were done using the current dataset and obtained the same results. Results don't change until the iterations get down to 2,500.

The current study estimated a P(Δ) of .223, which means the probability that any two cases are relatively stable is about 78%. The fact that there is a 78% probability of relative stability among the sample is impressive; however, the question of significance still remains. Estimating P(Δ) is a new analysis and there are currently no methods

designed to calculate how much (in)stability is required to accept or reject the hypothesis being tested. Barnes et al., (2016) offers two solutions using either calculating a standard error of proportion or bootstrapping. Neither standard error of proportion or bootstrapping has yet to be tried so a future study could be conducted to resolve this issue.

## THE DIFFERENCES BETWEEN ATTITUDINAL AND BEHAVIORAL MEASURES OF SELF-CONTROL

### Mean-Level Changes and Spearman Rank-Order Correlations

The composite measure for self-control is created from two independent measures of self-control measuring attitudinal self-control and behavioral self-control. Table 4.8 shows the pairwise correlations between the waves of attitudinal self-control and behavioral self-control. It makes sense that they would individually appear to correlate with each other because they make up the composite measure. However, the correlation coefficient for attitudinal self-control and behavioral self-control is only .14. This correlation is weak, even in social science research, the fact that these two measures are measuring the same concept it would make sense that the expected correlation would reach close to 1.00. A possible limitation is the measures themselves. The Cronbach alphas are bordering on unacceptable in social science research and the alphas for the attitudinal measures are higher than the behavioral measures. Due to the low alphas it is possible that stronger measures may produce a stronger correlation.

**Table 4.7** Descriptive statistics for attitudinal and behavioral self-control

| Variable | Attitudinal Low Self-Control | | | Behavioral Low Self-Control | | |
|---|---|---|---|---|---|---|
| | Mean | St. Deviation | Cronbach's alpha | Mean | St. Deviation | Cronbach's alpha |
| Self-Control$_{w1}$ | 28.24 | 3.99 | 0.43 | 41.53 | 6.01 | 0.62 |
| Self-Control$_{w2}$ | 27.55 | 4.95 | 0.67 | 43.13 | 4.08 | 0.53 |
| Self-Control$_{w3}$ | 29.13 | 4.53 | 0.70 | 43.76 | 4.33 | 0.61 |
| Self-Control$_{w4}$ | 29.80 | 5.00 | 0.73 | 44.28 | 4.48 | 0.61 |
| Self-Control$_{w5}$ | 28.39 | 4.90 | 0.66 | 44.39 | 4.70 | 0.63 |
| Self-Control$_{w6}$ | 30.10 | 4.70 | 0.70 | 44.20 | 4.40 | 0.62 |
| Self-Control$_{w7}$ | 29.61 | 5.37 | 0.74 | 45.00 | 3.99 | 0.67 |
| Self-Control$_{w8}$ | 28.79 | 5.40 | 0.75 | 44.37 | 5.40 | 0.77 |
| Self-Control$_{w9}$ | 29.93 | 5.68 | 0.78 | 44.83 | 3.80 | 0.66 |
| Self-Control$_{w10}$ | 29.38 | 5.71 | 0.77 | 44.97 | 3.63 | 0.61 |
| Self-Control$_{w11}$ | 28.65 | 5.44 | 0.76 | 44.41 | 4.26 | 0.67 |
| Self-Control$_{w12}$ | 29.70 | 5.54 | 0.73 | 44.59 | 4.35 | 0.53 |

St. Deviation = standard deviation; Cronbach's alpha = reliability coefficient

Sample size 165

**Table 4.8** Pairwise correlations of attitudinal self-control and behavioral self-control

| Variable | Wave-to-wave pairwise correlations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
| Self-Control$_{w1}$ | - | 0.67 | 0.44 | 0.42 | 0.41 | 0.31 | 0.29 | 0.46 | 0.34 | 0.33 | 0.26 | 0.33 |
| Self-Control$_{w2}$ | 0.63 | - | 0.60 | 0.61 | 0.66 | 0.38 | 0.35 | 0.41 | 0.39 | 0.45 | 0.35 | 0.41 |
| Self-Control$_{w3}$ | 0.47 | 0.47 | - | 0.75 | 0.59 | 0.62 | 0.59 | 0.45 | 0.60 | 0.58 | 0.53 | 0.56 |
| Self-Control$_{w4}$ | 0.45 | 0.50 | 0.49 | - | 0.68 | 0.66 | 0.67 | 0.47 | 0.64 | 0.67 | 0.62 | 0.69 |
| Self-Control$_{w5}$ | 0.45 | 0.47 | 0.52 | 0.58 | - | 0.51 | 0.39 | 0.45 | 0.46 | 0.54 | 0.43 | 0.51 |
| Self-Control$_{w6}$ | 0.49 | 0.46 | 0.51 | 0.56 | 0.52 | - | 0.68 | 0.45 | 0.70 | 0.60 | 0.72 | 0.68 |
| Self-Control$_{w7}$ | 0.43 | 0.45 | 0.53 | 0.55 | 0.46 | 0.59 | - | 0.45 | 0.74 | 0.62 | 0.65 | 0.55 |
| Self-Control$_{w8}$ | 0.36 | 0.46 | 0.46 | 0.36 | 0.49 | 0.55 | 0.61 | - | 0.55 | 0.53 | 0.48 | 0.50 |
| Self-Control$_{w9}$ | 0.52 | 0.51 | 0.46 | 0.55 | 0.59 | 0.64 | 0.67 | 0.60 | - | 0.62 | 0.72 | 0.62 |
| Self-Control$_{w10}$ | 0.52 | 0.44 | 0.56 | 0.48 | 0.58 | 0.53 | 0.56 | 0.57 | 0.65 | - | 0.63 | 0.61 |
| Self-Control$_{w11}$ | 0.44 | 0.42 | 0.49 | 0.36 | 0.45 | 0.52 | 0.51 | 0.54 | 0.62 | 0.56 | - | 0.77 |
| Self-Control$_{w12}$ | 0.40 | 0.37 | 0.57 | 0.41 | 0.52 | 0.49 | 0.49 | 0.57 | 0.63 | 0.69 | 0.60 | - |

Attitudinal self-control correlations below diagonal; behavioral self-control correlations above diagonal

St. Deviation = standard deviation; Cronbach's alpha = reliability coefficient

(All correlations are statistically significant at the .05 level)

Tables 4.9 and 4.10 depict Spearman rank-order correlations for attitudinal self-control and behavioral self-control. Table 4.9 shows the wave-to-wave rank-order correlations in each of the variables. There appears to be some significant rank differences in each of the self-control variables. It seems that the behavioral measures are more stable than attitudinal measures. This is interesting because someone might intuitively think how someone's attitude, like beliefs, would be more stable from day-to-day, whereas actions would be more likely to fluctuate. To further explore this phenomenon rank-order correlations were done between the attitudinal and behavioral variables. Table 4.10 shows the interesting rank-order correlation between variables. The rank-order correlations between the attitudinal and behavioral measures are quite low. These low correlations indicate that an individual's rank for attitudinal self-control is different than their behavioral self-control rank. Furthermore, those ranks are changing from wave-to-wave as indicated by the low correlation coefficients. In other words, participants may believe they feel lazy, or not in the mood to deal with other people yet their actions show they are exhibiting higher levels of self-control. A reverse scenario is also possible, people may believe they are not self-centered or have and aversion to risk but their behavior tells a different story. However, Spearman rank-order correlations are sensitive to dramatic changes of one individual regardless of how stable the other participants might be; therefore, interpretations of Spearman correlation should be interpreted with caution.

**Table 4.9** Stability correlations of attitudinal self-control and behavioral self-control

| Variable | Wave-to-wave Spearman rank-order correlations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
| Self-Control$_{w1}$ | - | 0.68 | 0.51 | 0.58 | 0.50 | 0.47 | 0.46 | 0.52 | 0.45 | 0.51 | 0.37 | 0.50 |
| Self-Control$_{w2}$ | 0.64 | - | 0.63 | 0.65 | 0.60 | 0.54 | 0.49 | 0.56 | 0.46 | 0.48 | 0.45 | 0.55 |
| Self-Control$_{w3}$ | 0.45 | 0.52 | - | 0.59 | 0.54 | 0.58 | 0.54 | 0.50 | 0.51 | 0.53 | 0.50 | 0.60 |
| Self-Control$_{w4}$ | 0.47 | 0.52 | 0.49 | - | 0.61 | 0.65 | 0.60 | 0.58 | 0.54 | 0.54 | 0.53 | 0.67 |
| Self-Control$_{w5}$ | 0.49 | 0.50 | 0.52 | 0.62 | - | 0.61 | 0.50 | 0.51 | 0.48 | 0.50 | 0.50 | 0.60 |
| Self-Control$_{w6}$ | 0.49 | 0.46 | 0.46 | 0.57 | 0.51 | - | 0.60 | 0.54 | 0.64 | 0.55 | 0.56 | 0.65 |
| Self-Control$_{w7}$ | 0.41 | 0.47 | 0.49 | 0.57 | 0.45 | 0.54 | - | 0.51 | 0.60 | 0.55 | 0.57 | 0.58 |
| Self-Control$_{w8}$ | 0.33 | 0.46 | 0.44 | 0.36 | 0.48 | 0.50 | 0.59 | - | 0.56 | 0.53 | 0.57 | 0.65 |
| Self-Control$_{w9}$ | 0.50 | 0.53 | 0.42 | 0.53 | 0.61 | 0.59 | 0.63 | 0.54 | - | 0.55 | 0.53 | 0.65 |
| Self-Control$_{w10}$ | 0.54 | 0.50 | 0.50 | 0.50 | 0.55 | 0.51 | 0.60 | 0.53 | 0.63 | - | 0.56 | 0.58 |
| Self-Control$_{w11}$ | 0.50 | 0.49 | 0.50 | 0.39 | 0.53 | 0.48 | 0.56 | 0.51 | 0.62 | 0.59 | - | 0.71 |
| Self-Control$_{w12}$ | 0.41 | 0.40 | 0.49 | 0.44 | 0.50 | 0.47 | 0.50 | 0.53 | 0.63 | 0.60 | 0.60 | - |

Attitudinal low self-control correlations below diagonal; behavioral low self-control correlations above diagonal

St. Deviation = standard deviation; Cronbach's alpha = reliability coefficient

(All correlations are statistically significant at the .05 level)

**Table 4.10** Wave-to-wave Spearman rank-order correlations between attitudinal self-control and behavioral self-control

| Attitudinal self-control | Behavioral self-control | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 |
| Self-Control$_{w1}$ | 0.21 | 0.18 | 0.16 | 0.21 | 0.16 | 0.21 | 0.21 | 0.13 | 0.20 | 0.18 | 0.25 | 0.15 |
| Self-Control$_{w2}$ | 0.20 | 0.20 | 0.18 | 0.14 | 0.13 | 0.12 | 0.23 | 0.19 | 0.14 | 0.17 | 0.24 | 0.17 |
| Self-Control$_{w3}$ | 0.19 | 0.21 | 0.20 | 0.17 | 0.18 | 0.14 | 0.26 | 0.20 | 0.20 | 0.20 | 0.23 | 0.22 |
| Self-Control$_{w4}$ | 0.17 | 0.12 | 0.13 | 0.21 | 0.14 | 0.10 | 0.14 | 0.14 | 0.15 | 0.15 | 0.27 | 0.15 |
| Self-Control$_{w5}$ | 0.15 | 0.09 | 0.06 | 0.14 | 0.06 | 0.08 | 0.17 | 0.15 | 0.17 | 0.12 | 0.15 | 0.09 |
| Self-Control$_{w6}$ | 0.10 | 0.07 | 0.06 | 0.12 | 0.16 | 0.04 | 0.15 | 0.18 | 0.09 | 0.15 | 0.16 | 0.06 |
| Self-Control$_{w7}$ | 0.08 | 0.10 | 0.08 | 0.17 | 0.14 | 0.19 | 0.16 | 0.25 | 0.17 | 0.07 | 0.18 | 0.13 |
| Self-Control$_{w8}$ | 0.16 | 0.07 | 0.00 | 0.16 | 0.13 | 0.05 | 0.07 | 0.11 | 0.16 | 0.09 | 0.21 | 0.15 |
| Self-Control$_{w9}$ | 0.22 | 0.17 | 0.08 | 0.15 | 0.21 | 0.09 | 0.18 | 0.19 | 0.18 | 0.17 | 0.23 | 0.11 |
| Self-Control$_{w10}$ | 0.16 | 0.09 | 0.08 | 0.16 | 0.12 | 0.20 | 0.08 | 0.09 | 0.19 | 0.09 | 0.18 | 0.13 |
| Self-Control$_{w11}$ | 0.19 | 0.10 | 0.00 | 0.09 | 0.13 | 0.10 | 0.14 | 0.23 | 0.07 | 0.12 | 0.20 | 0.04 |
| Self-Control$_{w12}$ | 0.11 | 0.08 | 0.04 | 0.13 | 0.06 | 0.04 | 0.14 | 0.15 | 0.09 | 0.08 | 0.22 | 0.07 |

(All correlations are statistically significant at the .05 level)

**Reliable Change Index (RCI) for Attitudinal and Behavioral Measures**

Table 4.11 depicts the Reliable Change Index scores for attitudinal and behavioral measures of self-control. Each of the measures show many of the same characteristics as the composite measure with some noticeable differences. First, it is important to recognize that few participants experience significant change from wave-to-wave. Attitudinal self-control does not increase or decrease in more than 12% of the sample and behavioral self-control does not increase or decrease in more than 5% of the sample. Much like the composite measure for self-control, the degree to which self-control increases for the attitudinal and behavioral measures is greater than how much it decreases. Second, given the reversal phenomenon witnessed in the composite measure attention should be directed to the waves of data collected from Wednesday afternoon through Friday morning. RCI w2-w1, RCI w5-w4, RCI w8-w7, and RCI w11-w10 were all collection time frames from Wednesday afternoon through Friday morning. All of these wavelengths show larger proportions of the sample experience decreases in self-control (with the exception of behavioral self-control) while the other waves show greater proportions of the sample experiencing increases in self-control throughout the week. Third, it appears that more participants are experiencing reliable change in their attitudes than their behavior.

**Table 4.11** Reliable Change Index (RCI)

| | Changes in Attitudinal Self-Control | | | Changes in Behavioral Self-Control | | |
|---|---|---|---|---|---|---|
| | % Increase | % Decrease | Any % of Chg. | % Increase | % Decrease | Any % o |
| RCI w2-w1 | 1.21(2) | 3.03(5) | 4.24(7) | 4.85(8) | 0.00(0) | 4.85(8) |
| RCI w3-w2 | 9.09(15) | 2.42(4) | 11.52(19) | 3.03(5) | 1.82(3) | 4.85(8) |
| RCI w4-w3 | 7.88(13) | 3.03(5) | 10.91(18) | 1.21(2) | 1.82(3) | 3.03(5) |
| RCI w5-w4 | 1.82(3) | 6.66(11) | 8.48(14) | 3.03(5) | 2.42(4) | 5.45(9) |
| RCI w6-w5 | 9.70(16) | 2.42(4) | 12.12(20) | 4.24(7) | 1.82(3) | 6.06(10) |
| RCI w7-w6 | 6.06(10) | 6.06(10) | 12.12(20) | 3.03(5) | 0.00(0) | 3.03(5) |
| RCI w8-w7 | 3.03(5) | 7.88(13) | 10.91(18) | 4.24(7) | 4.85(8) | 9.09(15) |
| RCI w9-w8 | 8.48(14) | 3.64(6) | 12.12(20) | 4.85(8) | 1.82(3) | 6.66(11) |
| RCI w10-w9 | 3.64(6) | 3.64(6) | 7.27(12) | 3.64(6) | 1.82(3) | 5.45(9) |
| RCI w11-w10 | 4.24(7) | 6.66(11) | 10.91(18) | 1.21(2) | 4.85(8) | 6.06(10) |
| RCI w12-w11 | 7.88(13) | 3.64(6) | 11.52(19) | 1.21(2) | 0.60(1) | 1.82(3) |

*Numbers in parentheses reflect the raw number of participants who experienced reliable change*

Sample size 165

Up to this point it seems there is a significant difference between attitudinal and behavioral measures of self-control. Not only does it appear that the rankings do not move in unison from wave-to-wave but larger proportions of the sample seem to experience attitudinal change much more than behavioral self-control. The following analyses (MMC, GBTM, and P(Δ)) further explored the within and between differences of these two measures as well as the probability of relative change.

**Multilevel Model for Change (MMC) of Attitudinal and Behavioral Self-Control**

Much like the composite measure, a series of multilevel models for change were conducted to help determine the within and between individual change for attitudinal self-control and behavioral self-control. Intercept only models were estimated for each of the measures and can be found in Table 4.12 (attitudinal self-control) and Table 4.13 (behavioral self-control). These intercept models provide the baseline levels of self-control for each of the measures. Furthermore, if you add the constant for attitudinal self-control and the constant for behavioral self-control you will get the baseline level of self-control for the composite measure.

The unconditional linear model in Table 4.12 provides some interesting differences when compared to the unconditional linear model found in Table 4.13. The standard deviation of linear growth found in Table 4.12 is somewhat greater than the standard deviation for linear growth found in Table 4.13. This would appear to confirm the RCI findings where the attitudinal self-control has a greater propensity to change within individuals. Additionally, the *rho* for each model of the attitudinal measure was

considerably poor .51, .45, .37 indicating relative instability. The behavioral measure of self-control on the other hand boasted a moderate *rho* for each model, .49, .62, and .72 indicating a fair amount of stability[33]. This would indicate that the two separate measures of self-control change similarly over time but differences still remain.

Graphical depictions of linear and quadratic models in Figure 4.7 show the linear and quadratic slopes of the behavioral measures are greater than the attitudinal measures for self-control. This can also be seen when comparing table 4.12 and 4.13. The coefficients for the linear and quadratic modeling in the behavioral measure are two to three time greater than the attitudinal measure. These results demonstrate some interesting differences between attitudinal and behavioral measures of self-control over time.

It is important to take into consideration the model fit when comparing these two sets of models. The composite measure for self-control indicated that the linear model best fit the data but it's a little more ambiguous when the composite measure was subdivided into attitudinal and behavioral measures. The quadratic model best fits the data for the behavioral measure but not necessarily the attitudinal measure. The unconditional non-linear growth model for attitudinal low self-control has the best *AIC*; however, the unconditional linear growth model boasts the best *BIC*. One thing to consider is the marginal difference linear and non-linear *BIC*s in the attitudinal. This marginal difference may be enough of a reason to accept the quadratic model as the best fitting.

[33] The adjectives "poor" and "moderate" used to describe the specific interclass correlation coefficients in this paragraph come from Koo and Li, (2016).

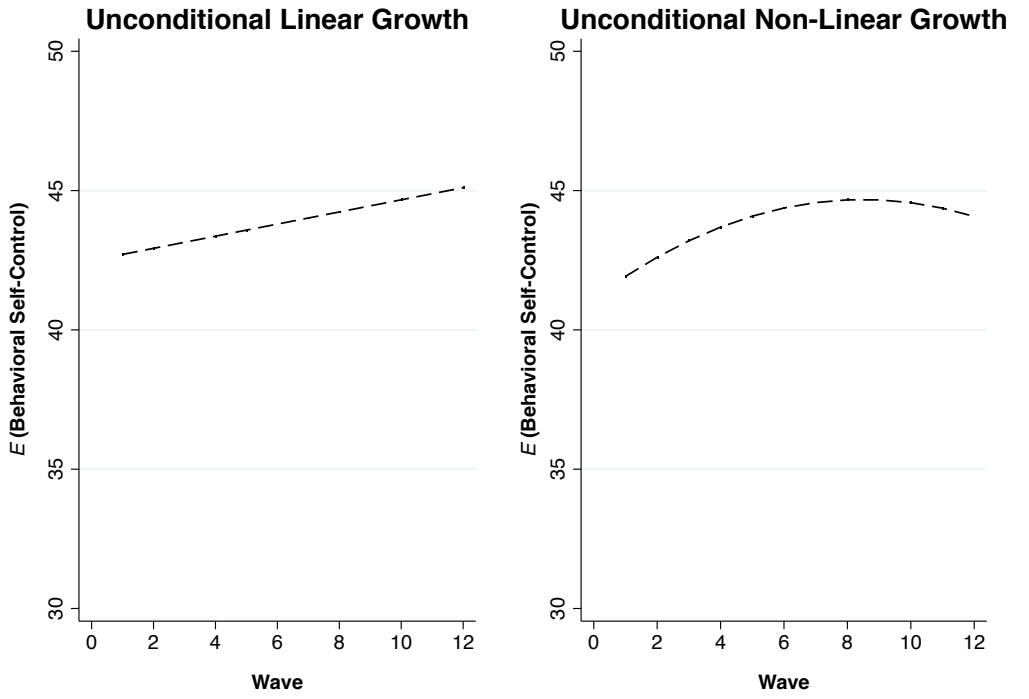



Figure 4.6 Unconditional Linear and Non-Linear Growth Multilevel Models for Change for Behavioral Self-Control

### P(Δ) For Attitudinal and Behavioral Self-Control

Just like the P(Δ) estimation for the composite measure of self-control, an estimation was done for attitudinal self-control. A separate estimation was conducted for the behavioral measure of self-control. These two estimations were then compared to see if a noticeable difference between the measures existed. These two measures used a sample size of 165 because these cases were the only complete cases left

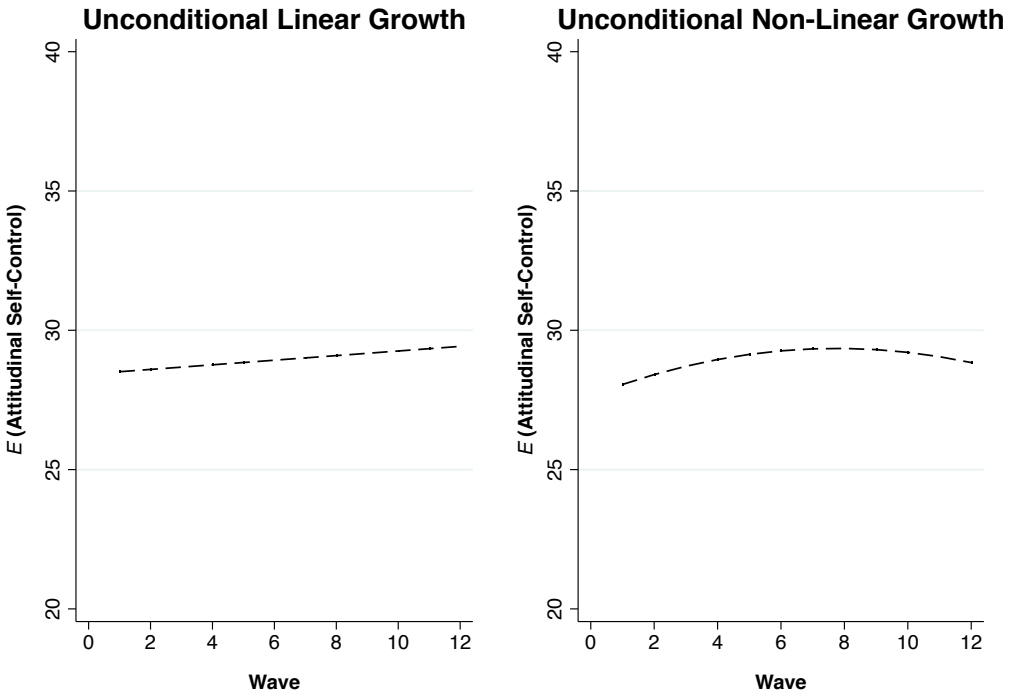



Figure 4.7 Unconditional Linear and Non-Linear Growth Multilevel Models for Change for Attitudinal Self-Control

after deleting cases with missing values. The attitudinal P(Δ) was estimated to be .34, meaning 1- P(Δ) was .65. This was slightly different than the composite measure's estimate (.26). This estimation means there is a 65% probability that the ranking of attitudinal self-control will change from wave-to-wave. The estimation for behavioral P(Δ) was .13. This was closer to the composite measure's estimation for P(Δ). This means there is a 87% probability of rank order change in the behavioral measure.

**Table 4.12** Multilevel models for change (MMC) in attitudinal self-control

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | St. Error | *b* | St. Error | *b* | St. Error |
| Intercept, $\gamma_{\gamma 00}$ | 28.92* | 0.25 | 28.43* | 0.24 | 27.64* | 0.28 |
| Wave, $\gamma\gamma_{10}$ | - | - | 0.08* | 0.02 | .43* | 0.09 |
| Wave$^2$, $\gamma\gamma_{20}$ | - | - | - | - | -.02* | 0.00 |
| Random effects | St. Dev. | St. Error | St. Dev. | St. Error | St. Dev. | St. Error |
| Intercept, $\sigma\sigma_0$ | 3.84 | 0.18 | 3.21 | 0.21 | 2.69 | 0.35 |
| Wave, $\sigma\sigma_1$ | - | - | 0.30 | 0.03 | 0.49 | 0.19 |
| Wave$^2$, $\sigma\sigma_2$ | - | - | - | - | 0.03 | 0.01 |
| Level 1 error variance, $\sigma$ | 0.51 | 0.02 | 0.44 | 0.03 | 0.36 | |
| *Rho*, ρ | 0.51 | | 0.45 | | 0.37 | |
| *ln*(*likelihood*)[*df*] | -.7626.54[3] | | -7574.07[6] | | -7561.34[10] | |
| *AIC* | 15259.08 | | 15160.15 | | 15142.69 | |
| *BIC* | 15276.75 | | 15195.49 | | 15201.59 | |

*b* = Unstandardized parameter estimate; St. Error = standard error; St. Dev. = standard deviation; Number of groups = 266

* $p < .05$ (two-tailed tests) Number of observations = 2671

**Table 4.12** Multilevel models for change (MMC) in behavioral self-control

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | St. Error | *b* | St. Error | *b* | St. Error |
| Intercept, $\gamma_{\gamma 00}$ | 43.75* | 0.22 | 42.49* | 0.27 | 41.13* | 0.36 |
| Wave, $\gamma\gamma_{10}$ | - | - | .21* | 0.02 | 0.83 | 0.09 |
| Wave$^2$, $\gamma\gamma_{20}$ | - | - | - | - | -0.04 | 0.00 |
| Random effects | St. Dev. | St. Error | St. Dev. | St. Error | St. Dev. | St. Error |
| Intercept, $\sigma\sigma_0$ | 3.39 | 0.16 | 4.00 | 0.22 | 4.88 | 0.31 |
| Wave, $\sigma\sigma_1$ | - | - | 0.33 | 0.02 | 0.91 | 0.10 |
| Wave$^2$, $\sigma\sigma_2$ | - | - | - | - | 0.05 | 0.00 |
| Level 1 error variance, $\sigma$ | 0.49 | 0.02 | 0.61 | 0.02 | 0.72 | |
| *Rho*, ρ | 0.49 | | 0.62 | | 0.72 | |
| *ln*(*likelihood*)[*df*] | -7380.86[3] | | -7277.04[6] | | -7228.11[10] | |
| *AIC* | 14767.92 | | 14566.92 | | 14476.24 | |
| *BIC* | 14785.60 | | 14601.42 | | 14535.14 | |

*b* = Unstandardized parameter estimate; St. Error = standard error; St. Dev. = standard deviation Number of groups = 266

* $p < .05$ (two-tailed tests) Number of observations = 2671

This makes sense because one would intuitively think actions would change more than beliefs or attitudes. However, given the fact that the difference in estimation is a mere .07 it is difficult to accept there is a significant difference. The dilemma faced in the previous section with regards to significance of the estimation must also be considered in this analysis. Because a standard error and/or significance cannot be readily obtained the difference between the estimations cannot be determined to be significant. Regardless, these differences can be used a benchmark to further explore these questions.

## DOES THE LAW OF LONGITUDINAL RELATIONSHIPS DRIVE THE STABILITY OF SELF-CONTROL?

If the law of longitudinal relationships was the only factor in stability then the correlations between waves would completely explain the stability of self-control. This appeared to be the immediate case because of the strong correlations of stability and the means from wave-to-wave. However, the phenomenon witnessed every week among the measures of self-control must be taken into consideration. To verify if these correlations had any bearing on the stability between each wave another test was conducted using simulated data. To do the simulation, 2000 observations were created using each wave-to-wave correlation. Using the RCI score of any change (-1) from wave-to-wave and their standard deviations another 2000 observations were created. These new variables were then regressed on each other to see if the correlations between waves had a noticeable impact on stability.

Table 4.14 shows the weak correlations between the wave-to-wave correlations and the stability of self-control between waves. Also, while several coefficients were close to being significant only one was actually statistically significant. This is interesting because these results provide evidence that correlations between waves to do not determine the stability of a specific factor, which was self-control in the current study. This means that other factors could determine (in)stability from wave-to-wave. However, it is important to recognize that the coefficients that reached or were close to reaching statistical significance were present in the early waves but not as prominent in the latter waves. This could be evidence confirming the law of longitudinal relationships that states, when the wavelength increases the evidence for stability will decrease. Yet the differences are much too small in the current study to confidently infer such a concept. Future studies can explore which variables contribute to the stability of self-control over time by using this method.

**Table 4.14** The law of longitudinal relationship verse stability

| | Coefficients and standard errors | |
|---|---|---|
| | Coef. | Std. Error |
| w2-w1 | -0.01 | 0.02 |
| w3-w2 | 0.03* | 0.01 |
| w4-w3 | 0.03 | 0.01 |
| w5-w4 | -0.02 | 0.01 |
| w6-w5 | 0.02 | 0.02 |
| w7-w6 | -0.03 | 0.02 |
| w8-w7 | 0.00 | 0.01 |
| w9-w8 | -0.01 | 0.02 |
| w10-w9 | 0.00 | 0.01 |
| w11-w10 | 0.00 | 0.01 |
| w12-w11 | 0.03 | 0.02 |

Std. Error = standard error

* $p < .05$ (two-tailed tests)

# CHAPTER 5

# DISCUSSION AND CONCLUSION

Gottfredson and Hirschi (1990) suggested that self-control is a relatively stable construct meaning an individual's ranking will change throughout the life- course. Several studies have been conducted to either prove or disprove this theoretical concept (Arneklev, 1998; Barnes, 2016; Burt et al., 2014; Na & Paternoster, 2012). Short-term studies seem to give support for the stability hypothesis but long-term studies seem to refute the idea that stability exists. Scholars from a number of different disciplines have devoted much time to studying self-control; however, relatively few have devoted an equal amount of time to how self-control changes over time, from a relative or absolute perspective. The current study sought to explore the nature of self-control stability from a short-term perspective. Theoretically this is necessary because low self-control is a trait that leads people to engage in momentary, short-sighted behavior; therefore, studying this kind of behavior using long-term, drawn-out methodology has its limitations. Several key findings from the current study warrant further discussion.

It has become common to conduct a variety of statistical analyses and estimate various models to determine the stability of self-control (Barnes et al., 2016; Burt et al., 2014; Na & Paternoster, 2012). This strategy was used to answer the first two research questions. That is, (1) is self-control relatively stable in the short-term, and its subquestion, if self-control proves to be unstable in the short-term what variables

contribute to the instability, and (2) what are the differences between attitudinal self-control and behavioral measures of self-control? The means and Spearman rank order correlations, evidence showed self-control to be very stable in the short-term. Similar results were found when estimating the MMC, GBTM, and P(Δ). In fact, a great amount of absolute stability was also found when the MMC and GBTMs were estimated. These coefficients were incredibly small showing minimal growth over time. Although these coefficients were small, they compare to past studies which saw continued growth in self-control over time (Barnes et al., 2016). The most interesting results came from the RCI of the composite measure of self-control.

The RCI for the composite measure of self-control showed a distinct pattern of the sample experiencing an initial increase in self-control, followed by a dramatic decrease in self-control, which was then followed by another increase in self-control. While low self-control is correlated with criminal activity, and crime tends to spike at specific days of the week, no study has ever captured the dip in self-control during these days. The current study seems to have captured this phenomenon. Every week the surveys that were administered on Wednesday and completed between Wednesday afternoon and Friday morning showed as much as 6.06% of the sample experiencing a reliable decrease in self-control. Interestingly enough the following surveys, which were completed over the weekend often saw the largest proportion of the sample experiencing an increase in self-control. This would appear to coincide with the sociological and psychological literature on self-control. People choose to exercise self-control when they want to or when they have to (Tittle et al., 2004); however, people seem to also fail, return to their baseline level of self-control, and then start again (Baumeister, Heatherton,

& Tice, 1994; Baumeister et al., 2007; Baumeister & Tierney, 2011). Regardless of absolute levels of change, the majority of the evidence in the current study supports the idea of relative stability.

The MMC and GBTM moderate and strong evidence for relative stability of self-control within the sample. The linear and quadratic coefficients are very small for the fixed and random effects. The model fit for the quadratic model is not dramatically better that the linear model so making the model more complex would risk overfitting the model. This became particularly evident during the GBTM when models were run with increasingly more groups. While it became apparent after estimating the two-group model the single group was simply split in two separate groups as opposed to identifying two unique groups. However, to be exhaustive, models with as many as five groups were estimated. The result was 5, almost completely parallel trajectories, even when the quadratic terms were incorporated.

The P(Δ) estimation provided a probability of 74% stability within the sample. This is much higher than the 49% stability reported by Barnes et al., (2016) using the Pathways to Desistance data. While this is impressive there is no hypothesis test to determine whether or not self-control is stable in the current sample. Future research should determine the best method for hypothesis testing which will help shed light on these results. However, until a hypothesis test is constructed it is pretty safe to say, considering the results of five other types of analysis, self-control within the current study's sample is relatively stable.

The analyses conducted for behavioral self-control and attitudinal self-control were similar, as they theoretically should be since they are measuring the same concept,

but there were some notable differences between them when analyzed. A reasonable argument can be made that these measures are quite stable when the means are compared and the rank-order change is determined. Yet, a great amount of instability was found when the Spearman rank-order correlations were estimate between the attitudinal and behavioral measures. The RCI scores, like the composite measure, yielded interesting results about the reliable change of self-control. Larger proportions of the sample experienced reliable change in attitudinal self-control than behavioral self-control. However, this may be the nature of how the measures were constructed. Referring back to chapter 3, the attitudinal measures were 4-point Likert scales while the behavioral measures were top-coded count variables. Yet, this does not account for, and sometimes contradicts, phenomena witnessed elsewhere in the study.

The MMC and P(Δ) suggested moderate relative stability among both constructs of self-control. When the MMC tables and figures are compared it seemed individuals in the sample became increasingly good at curbing behavior indicative of low self-control; however, this changed in the last couple waves. On the other hand, while attitudinal self-control increased over time, the linear effect was not to the same degree as the behavioral measure and their different interclass correlation coefficients reflect this. Regardless, the differences are not extreme and the figures are qualitatively the same. The same can be said for the estimation of P(Δ). While the probability of change is different, the difference coupled with the standard deviations do not warrant the claim that one is inherently more unstable than another.

The law of longitudinal relationships would dictate that each correlation of means from wave-to-wave would drive, or at least be associated with, the stability of any factor

in the concurrent wave (Moffitt, 1993). The current study does not support this hypothesis. The current study shows virtually no relationship between the correlation coefficients and the stability from wave-to-wave. This actually opens up a field for greater exploration because the answer for stability is completely detached from wave-to-wave correlations. This means the stability of self-control can be due to either population heterogeneity or state dependence. However, the short time period does not give us the opportunity to test a state dependence theory using the current study's data. Future studies may be able to track aspects of constant stress, living conditions with roommates, or conduct an experiment by collecting baseline data before the start of the semester. The current study did its best to limit the effects of moving, starting a new semester, or starting college all together; however, given the fact that student have already gone through these experiences our results may have been hindered. Since the current study's results point to strong relative stability of self-control in the short-term the next series of studies should explore why so much stability exists.

**Policy and Theoretical Implications**

The current study had three interesting outcomes that can impact the conceptualization of self-control how they are used to inform effective policy. First, there was a great deal of relative stability among the sample population. This stability means policy can be directed evenly across a population instead of at a group of at-risk offenders. While it may be more cost effective to target a specific group of individuals, these individuals still have to be identified and all individuals may not be identified to receive some form of policy intervention. Therefore, it may be easier to broadly

implement a strategy designed to increase or maintain self-control to prevent deviance. This also reaffirms proposition made by Gottfredson and Hirschi (1990). However, the current study suggests that stability research should be divided by time. Burt et al., (2014) used long wavelengths and studies like Arneklev et al., (1998) used short wavelengths. There are important variables that affect short-term and long-term attitudes and behaviors that should be taken into consideration when studying self-control. Therefore, making broad statements may be misleading

The second outcome that can be used to inform policy construction and implementation are the absolute differences found in self-control. Participants in the study showed significant losses in self-control toward the end of the work week but would return to normal by Monday. The noticeable drops in self-control can be observed in Figure 5.1. Fridays can be seen in waves 5, 8, and 11 in Figure 5.1. Table 5.1 shows the difference between wave 4 and waves 5, 8, and 11 are statistically significant. Wave 4 was used as the reference category because it was the first "normal" day participants completed surveys after hurricane Irma passed through the south eastern United States. Therefore, it would be more effective to direct any intervention at a specific time rather than at any particular demographic or at-risk population.

Additionally, the current study showed some interesting differences between attitudes and behaviors. Policies could be put into place to improve the state of mind in an attempt to curb behavioral manifestations of decreased levels of self-control experienced toward the end of the week. However, since attitudes seem to change more dramatically than behaviors the interventions should be tailored more specifically. The current study used a student sample, but the same could be applied to employees in an

office. Furthermore, the similar stabilities found between attitudinal and behavioral measures match the similarities found when testing deviance (Tittle et al., 2003). Testing stability in the future does not have to be bound by particular measures regardless of the wavelength.

The third finding of interest was the environmental influence of Hurricane Irma on self-control. Hurricane Irma was a unique event and although it coincided with a dramatic drop in self-control, jumping to the conclusion that hurricanes dramatically effect self-control might be too much. It is more logical to assume if an individual's daily routine is disturbed then self-control will decrease. A hurricane, snow day, "playing hooky" from work/school, school graduation, or celebrating a holiday have the capability to affect the way individual experience life, but these events may not be created equal. Figure 5.2 shows just how low self-control was during the first three waves of data collection. In the case of the current study, the weekends and a hurricane were sufficient disruptions in the sample's daily routines to significantly decrease self-control in the sample. Therefore, a similar strategy to use a time-targeted intervention can be implemented. In addition to the physical preparations used to combat the effects of a hurricane, interventions could be directed at the population as well to minimize the decrease in self-control that may transpire. Psychological tests of self-control seem to use more experiments than sociological tests. While it may be close to impossible to predict and successfully implement a survey to capture the effects of a natural disaster, it is possible to use the workweek as a natural experiment to test how self-control changes throughout the week and its different manifestations.

Table 5.1 Self-control contrasts between waves

| Wave | Contrast | SE |
|---|---|---|
| 1 vs 4 | -0.14* | 0.01 |
| 2 vs 4 | -0.14* | 0.01 |
| 3 vs 4 | -0.04* | 0.01 |
| 5 vs 4 | -0.05* | 0.01 |
| 6 vs 4 | 0.01 | 0.01 |
| 7 vs 4 | 0.00 | 0.01 |
| 8 vs 4 | -0.03* | 0.01 |
| 9 vs 4 | 0.01 | 0.01 |
| 10 vs 4 | 0.00 | 0.02 |
| 11 vs 4 | -0.05* | 0.02 |
| 12 vs 4 | -0.00 | 0.02 |

SE = Standard Error
*= $p<.05$

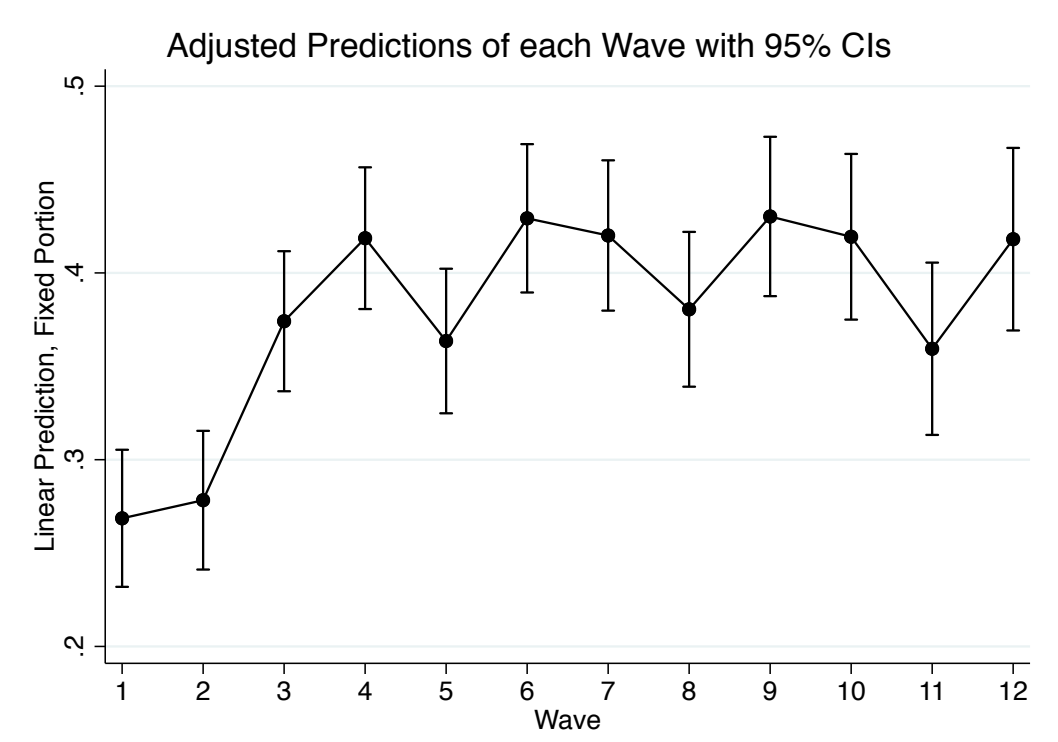



Figure 5.1 Self-control from wave-to-wave

A final thought on the policy implications of this study is the value of short-term intervention. The sample used in the current study is a transient population; therefore, it would not be beneficial for employers (or caretakers) of such populations to utilize long-term strategies. Not only should employers focus on a particular strategy but they should focus on the metaphorically transient nature of the population. College students are usually 18-22 years old and occupy the pinnacle of the age-crime curve. If employers (or caretakers) can use short-term, cost-effective strategies to increase or maintain self-control then they will eventually reach the age where the probability of deviance is reduced. Probationary status for new, young employees could help companies, schools, and communities minimize deviance.

**Limitations**

There are certain limitations to the current study that should be addressed. The sample was drawn from a population of college students at one university. Student populations have been used to test the validity of the measures similar to the ones used in the current study (Higgins, 2007; Williams, Fletcher, & Ronan, 2007); however, validity still remains a concern. Students may be less honest about certain activities including crime and give socially desirable answers. The participants were recruited from a population of students who were taking classes in the department of criminology and criminal justice at the time the study was conducted. Although it does not imply that every participant was a criminal justice and criminology major it severely limits the generalizability of the study's findings even beyond a general student sample even if

research suggests no difference between criminal justice majors and non-majors exists (Hensley et al., 2003). Even if criminal justice students are like other students, students may not be like other people. Common differences form the general population like the fact that college students are younger, have different life experiences, come from a different income bracket, possess different interests, and a distinct subculture makes generalizability difficult (Payne & Chappell, 2008). The current study was more exploratory in nature and used simple methodology. A future study will ideally use a nationally representative sample.

There were also issues concerning the attitudinal and behavioral measures for self-control. First, the Cronbach alphas were relatively low. Although the alphas fared better in the current study than in the pilot study they did not quite reach the usually cut off point of .7. This was justified by stating the current study is exploratory (Nunnally, 1978), but future studies may want to take these results into consideration before implementing the measures that were constructed for this study. More specifically, future researchers should reevaluate the validity of the behavioral measures and consider revising them if some items, or scaling structure, proves to be inappropriate.

Furthermore, future studies should use measures that are applicable during any timeframe of the study. The behavioral measures used in the current study do not satisfy this requirement. Many items that made up the behavioral measure of self-control are school related. Weekend classes are not offered where the current study took place; therefore, many of the behavioral measures could have artificially low results. Ideally, and most often students did, take the survey within a couple hours of receiving it; however, students may have taken the Friday survey as late as Sunday morning. This is a

problem because the participants who fell in this category had all day on Saturday to recall events but no classes to skip or arrive late. This may be the cause for the increase in self-control seen in this wave of data collection. Yet, attitudinal low self-control showed similar results without the issues outlined in the behavioral measure. Regardless of the results, the behavioral items should be reconsidered in future studies.

Moreover, the question remains as to whether the stability witnessed in the current study was an artifact of the measures as opposed to a genuine observation of relative stability. Two hypotheses can be gleaned from the study's results. First, if items are used that are not likely to change over time then self-control will remain relatively stable. Second, if absolute stability exists then serious questions can be raised about the validity of the measures. Taking these two hypotheses into consideration is essential to determine measurement validity in a stability study.

The relative stability seen in the current study is enough to call into question the validity of the measures. First, the measures used may not be compatible with the homogeneity of the sample. The current study used a student sample from one university which means the students all have similar schedules. Every student has up to several hours of class a day, no responsibility over the weekend, and a great deal of free time apart from homework. The measures were tailored to this specific population possibly resulting in a relatively stable outcome. Future studies should use a more heterogeneous population with more general measures to determine if homogeneity directly affects the relative stability.

Yet, absolute stability also provides unique information as to whether the measures are valid. If the instrument suffered from some sort of primacy or recency

(within and between waves) effects then more absolute stability along with relative stability would be apparent. The current study found great deal of absolute instability throughout the study. Additionally, absolute stability within attitudinal and behavioral measures varied to a similar degree while remaining relatively stable. If stability were an artifact of the measures then there would be some systematic and methodological explanation for the similarities seen in both measures of self-control. While the current study cannot answer these questions definitively, precautions should be taken in future studies to avoid misidentifying stability.

Lastly, there were some technical issues regarding the software, SurveySwipe. These technical difficulties delayed the launch of the current study by 10 days. This is important because recruitment began one week before the scheduled launch of the study. Exactly 300 participants signed up for the current study by downloading the app. However, a logical argument can be made that participants who passively quit, or deleted the app, before the actually start date (10 days after the original) possessed lower baseline levels of self-control than the rest of the sample. This could have potentially skewed the results and affected the stability of the low self-control measures. Only future studies can determine if this was the case.

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## APPENDIX A: RELIABLE CHANGE INDEX (RCI) CODE

(The following code and analysis was written and done using STATA)

```
* ------------------------------------------------------------------------------
*RCI
* ------------------------------------------------------------------------------
* Christensen & Mendoza's RCI
* where RCI = (t2-t1)/sdiff
* note, numerator is simply the diff in score between two measurement periods
* denominator is standard error of measurement (SEM) (not simply the stand error)
* the SEM accounts for measurement error (i.e., alpha reliability)

use "_wide_data_Timpuls.dta",clear
quietly keep id Timpuls*

quietly drop if Timpuls1==.
quietly drop if Timpuls2==.
quietly drop if Timpuls3==.
quietly drop if Timpuls4==.
quietly drop if Timpuls5==.
quietly drop if Timpuls6==.
quietly drop if Timpuls7==.
quietly drop if Timpuls8==.
quietly drop if Timpuls9==.
quietly drop if Timpuls10==.
quietly drop if Timpuls11==.
quietly drop if Timpuls12==.
```

```
* gen variables holding info needed for denominator

foreach var of varlist Timpuls* {
quietly sum `var'
quietly gen sd`var'=`r(sd)'
}
capture gen alpha1=.59
capture gen alpha2=.67
capture gen alpha3=.71
capture gen alpha4=.73
capture gen alpha5=.60
capture gen alpha6=.69
capture gen alpha7=.66
capture gen alpha8=.79
capture gen alpha9=.73
capture gen alpha10=.67
capture gen alpha11=.78
capture gen alpha12=.60



* w2-w1
gen RCI_2_1=(Timpuls2-Timpuls1)/sqrt([sdTimpuls2*sqrt(1-
        alpha2)]^2+[sdTimpuls1*sqrt(1-alpha1)]^2)
sum RCI_2_1, d

* w3-w2
gen RCI_3_2=(Timpuls3-Timpuls2)/sqrt([sdTimpuls3*sqrt(1-
        alpha3)]^2+[sdTimpuls2*sqrt(1-alpha2)]^2)
sum RCI_3_2, d
```

```
* w4-w3

gen RCI_4_3=(Timpuls4-Timpuls3)/sqrt([sdTimpuls4*sqrt(1-
        alpha4)]^2+[sdTimpuls3*sqrt(1-alpha3)]^2)

sum RCI_4_3, d


* w5-w4

gen RCI_5_4=(Timpuls5-Timpuls4)/sqrt([sdTimpuls5*sqrt(1-
        alpha5)]^2+[sdTimpuls4*sqrt(1-alpha4)]^2)

sum RCI_5_4, d


* w6-w5

gen RCI_6_5=(Timpuls6-Timpuls5)/sqrt([sdTimpuls6*sqrt(1-
        alpha6)]^2+[sdTimpuls5*sqrt(1-alpha5)]^2)

sum RCI_6_5, d


* w7-w6

gen RCI_7_6=(Timpuls7-Timpuls6)/sqrt([sdTimpuls7*sqrt(1-
        alpha7)]^2+[sdTimpuls6*sqrt(1-alpha6)]^2)

sum RCI_7_6, d


* w8-w7

gen RCI_8_7=(Timpuls8-Timpuls7)/sqrt([sdTimpuls8*sqrt(1-
        alpha8)]^2+[sdTimpuls7*sqrt(1-alpha7)]^2)

sum RCI_8_7, d


* w9-w8

gen RCI_9_8=(Timpuls9-Timpuls8)/sqrt([sdTimpuls9*sqrt(1-
        alpha9)]^2+[sdTimpuls8*sqrt(1-alpha8)]^2)

sum RCI_9_8, d
```

```
* w10-w9
gen RCI_10_9=(Timpuls10-Timpuls9)/sqrt([sdTimpuls10*sqrt(1-
        alpha10)]^2+[sdTimpuls9*sqrt(1-alpha9)]^2)
sum RCI_10_9, d

* w11-w10
gen RCI_11_10=(Timpuls11-Timpuls10)/sqrt([sdTimpuls11*sqrt(1-
        alpha11)]^2+[sdTimpuls10*sqrt(1-alpha10)]^2)
sum RCI_11_10, d

* w12-w11
gen RCI_12_11=(Timpuls12-Timpuls11)/sqrt([sdTimpuls12*sqrt(1-
        alpha12)]^2+[sdTimpuls11*sqrt(1-alpha11)]^2)
sum RCI_12_11, d

* summary stats of RCI
sum RCI*,d
centile  RCI*, centile(2.5 97.5)
keep RCI*
saveold "_rci.dta",v(11) replace

* create dummy variable of ANY reliable change
foreach var of varlist RCI* {
gen `var'D = 0
replace `var'D = 1 if `var'>=1.96 | `var'<=-1.96
replace `var'D = . if `var'==.
}

sum RCI*D
```

```
* create dummy variable of INCREASED reliable change
foreach var of varlist RCI* {
gen `var'D_inc = 0
replace `var'D_inc = 1 if `var'>=1.96
replace `var'D_inc = . if `var'==.
}

sum RCI*D_inc


* create dummy variable of DECREASED reliable change
foreach var of varlist RCI* {
gen `var'D_dec = 0
replace `var'D_dec = 1 if `var'<=-1.96
replace `var'D_dec = . if `var'==.
}

sum RCI*D_dec

sum RCI*D*

* ------------------------------------------------------------------------
```

## APPENDIX B: CODE FOR OBTAINING CRONBACH ALPHAS

(The following code and analysis was written and done using STATA)

```
* Keep the variables of interest and drop the rest from the dataset
keep id wave instantgratify concernednow lazy bored risk reckless gooutside physical
        dontdealwithpeople inneed angry disagree actcruelRev payingattentionRev
        latetoclassRev seatbeltRev cheatorlieRev skipclassRev tobaccoRev
        drinkalcoholRev


* This "foreach" command goes through every case and drops all missing values
foreach v of var * {
        drop if missing(`v')
}


* "xlist" essentially allows me to pick up and analyze variables as a group///
* instead of continually typing them out.
global xlist actcruelRev payingattentionRev latetoclassRev seatbeltRev cheatorlieRev
        skipclassRev tobaccoRev drinkalcoholRev
global id id


* "preserve" allows me to save the changes I made to this points so dont have///
* to reenter the previous commands 12 times
preserve


* Isolate the wave I want to get my alpha for.
keep if wave==8


* Get the alpha for that wave
```

alpha $xlist

* Put the alpha in its respective place in the RCI code
* Restore the data back to the preservation point
restore

* Change the wave number and rerun the code

## APPENDIX C: SENSITIVITY CHECK FOR COMPOSITE SELF-CONTROL RELIABLE CHANGE INDEX (RCI) SCORES

Table C.1: Sensitivity check for composite self-control Reliable Change Index (RCI) scores

| | Sample size per wavelength | Percentage Increase | Percentage Decrease | Any % of Change |
|---|---|---|---|---|
| RCI w2-w1 | 244 | 1.63(4) | 2.04(5) | 3.68(9) |
| RCI w3-w2 | 238 | 5.04(12) | 1.68(4) | 6.72(16) |
| RCI w4-w3 | 237 | 2.53(6) | 1.26(3) | 3.79(9) |
| RCI w5-w4 | 228 | 1.75(4) | 3.07(7) | 4.82(11) |
| RCI w6-w5 | 221 | 2.71(6) | 1.80(4) | 4.52(10) |
| RCI w7-w6 | 220 | 1.36(3) | 2.27(5) | 3.36(8) |
| RCI w8-w7 | 219 | 2.73(6) | 5.47(12) | 8.21(18) |
| RCI w9-w8 | 210 | 4.28(9) | 2.38(5) | 6.66(14) |
| RCI w10-w9 | 202 | 1.48(3) | 3.46(7) | 4.95(10) |
| RCI w11-w10 | 194 | 2.06(4) | 6.18(12) | 8.24(16) |
| RCI w12-w11 | 170 | 3.52(6) | 1.76(3) | 5.29(9) |

*Numbers in parentheses represent the actual number of participants that experienced reliable change.*

## APPENDIX D: SENSITIVITY CHECK FOR RELIABLE CHANGE INDEX (RCI) FOR ATTITUDINAL AND BEHAVIORAL SELF-CONTROL

Table D.1: Sensitivity check for Reliable Change Index (RCI) for attitudinal and behavioral self-control

| | Sample size per wavelength | Changes in Attitudinal Self-Control | | | Changes in Behavioral Self-Control | | |
|---|---|---|---|---|---|---|---|
| | | % Increase | % Decrease | Any % of Chg. | % Increase | % Decrease | Any % of Chg. |
| RCI w2-w1 | 244 | 1.22(3) | 2.86(7) | 4.09(10) | 4.50(11) | 0.41(1) | 4.91(12) |
| RCI w3-w2 | 238 | 6.30(15) | 2.10(5) | 8.40(20) | 2.94(7) | 1.26(3) | 4.20(10) |
| RCI w4-w3 | 237 | 4.64(11) | 1.68(4) | 6.32(15) | 1.68(4) | 0.42(1) | 2.10(5) |
| RCI w5-w4 | 228 | 2.21(5) | 5.26(12) | 7.45(17) | 3.50(8) | 2.19(5) | 5.70(13) |
| RCI w6-w5 | 221 | 6.33(14) | 1.80(4) | 8.14(18) | 3.16(7) | 1.35(3) | 4.52(10) |
| RCI w7-w6 | 220 | 4.45(10) | 5.90(13) | 10.45(23) | 2.27(5) | 1.81(4) | 4.09(9) |
| RCI w8-w7 | 219 | 2.28(5) | 4.56(10) | 6.84(15) | 2.73(6) | 4.56(10) | 7.30(10) |
| RCI w9-w8 | 210 | 6.19(13) | 3.80(8) | 10.00(21) | 4.28(9) | 1.90(4) | 6.19(13) |
| RCI w10-w9 | 202 | 3.96(8) | 3.46(7) | 7.42(15) | 2.97(6) | 2.47(5) | 5.44(11) |
| RCI w11-w10 | 194 | 2.06(4) | 5.15(10) | 7.21(14) | 1.03(2) | 4.12(8) | 5.15(10) |
| RCI w12-w11 | 170 | 3.52(6) | 2.35(4) | 5.88(10) | 1.17(2) | 0.58(1) | 1.76(3) |

*Numbers in parentheses reflect the raw number of participants that experienced reliable change*

## APPENDIX E: MULTILEVEL MODELS FOR CHANGE (MMC) IN SELF-CONTROL WITH COVARIATES

Table E.1: Multilevel models for change (MMC) in self-control with covariates

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | SE | *b* | SE | *b* | SE |
| Intercept, $\gamma_{\gamma 00}$ | 0.37* | 0.02 | -0.30 | 0.23 | -.37 | 0.23 |
| Wave, $\gamma\gamma 10$ | - | - | .01* | 0.03* | 0.04* | 0.00 |
| Wave$^2$, $\gamma\gamma 20$ | - | - | - | - | -0.00* | 0.00 |
| Sex | | | | | | |
| Male | - | - | -0.04 | 0.03 | -0.04 | 0.03 |
| Female | - | - | - | - | - | - |
| Race | | | | | | |
| White | - | - | -0.02 | 0.09 | -0.03 | 0.09 |
| Black | - | - | 0.01 | 0.10 | 0.01 | 0.10 |
| Hispanic | - | - | -0.00 | 0.14 | -0.01 | 0.14 |
| Asian | - | - | -0.21 | 0.13 | -0.21 | 0.13 |
| Other | - | - | - | - | - | - |
| Age | - | - | 0.01 | 0.00 | 0.01 | 0.00 |
| Education | - | - | 0.00 | 0.02 | 0.00 | 0.02 |
| Home intactness | - | - | | | | |
| Mother only | - | - | 0.17 | 0.12 | 0.17 | 0.12 |
| Father only | - | - | 0.20 | 0.15 | 0.20 | 0.15 |
| Mom and Dad | - | - | 0.18 | 0.12 | 0.17 | 0.12 |
| Other | - | - | - | - | - | - |

Appendix E: Multilevel models for change (MMC) in self-control with covariates (*continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Current residence | - | - | | | | |
| On campus | - | - | 0.24* | 0.10 | 0.24* | 0.10 |
| Off campus house | - | - | 0.13 | 0.10 | 0.14 | 0.10 |
| Off campus apt. | - | - | 0.18 | 0.10 | 0.18 | 0.10 |
| Other | - | - | - | - | - | - |
| Childhood residence | - | - | | | | |
| Farm | - | - | -0.05 | 0.09 | -.05 | 0.09 |
| Rural | - | - | 0.02 | 0.05 | 0.02 | 0.05 |
| Small Town | - | - | -0.02 | 0.05 | -0.02 | 0.05 |
| Big Town | - | - | -0.00 | 0.03 | -0.00 | 0.03 |
| City | - | - | - | - | - | - |
| Random effects | St. Dev. | SE | St. Dev. | SE | St. Dev. | SE |
| Random variance in Intercept, $\sigma\sigma_0$ | 0.24 | 0.01 | 0.22 | 0.01 | 0.24 | 0.01 |
| Random variance in Wave, $\sigma\sigma_1$ | - | - | 0.01 | 0.00 | 0.04 | 0.00 |
| Random variance in Wave$^2$, $\sigma\sigma_2$ | - | - | - | - | 0.00 | 0.00 |
| Level 1 error variance, $\sigma_\varepsilon$ | 0.57 | 0.02 | 0.56 | 0.03 | 0.61 | 0.03 |
| *Rho*, $\rho\rho$ | 0.57 | | 0.56 | | 0.61 | |
| *ln*(*likelihood*)[*df*] | 22.09[3] | | 122.02[23] | | 155.87[27] | |
| *AIC* | -38.19 | | -198.05 | | -257.75 | |
| *BIC* | -20.52 | | -63.21 | | -99.46 | |

*b* = Unstandardized parameter estimate; SE = standard error; St. Dev. = standard deviation
* $p < .05$ (two-tailed tests)

APPENDIX F: MULTILEVEL MODELS FOR CHANGE (MMC) BEHAVIORAL SELF-CONTROL WITH COVARIATES

Table F.1: Multilevel models for change (MMC) behavioral self-control with covariates

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | SE | *b* | SE | *b* | SE |
| Intercept, $\gamma_{00}$ | 43.75* | 0.22 | 39.14* | 3.40 | 38.31* | 3.41 |
| Wave, $\gamma_{10}$ | - | - | .21* | 0.02 | 0.83* | 0.09 |
| Wave$^2$, $\gamma_{20}$ | - | - | - | - | -0.04* | 0.00 |
| Sex | - | - | | | | |
| Male | - | - | -0.95 | 0.53 | -0.90 | 0.00 |
| Female | - | - | - | - | - | - |
| Race | | | | | | |
| White | - | - | 0.99 | 1.41 | 0.76 | 1.42 |
| Black | - | - | 1.20 | 1.50 | 1.07 | 1.50 |
| Hispanic | - | - | -0.64 | 2.13 | -0.81 | 2.13 |
| Asian | - | - | -1.84 | 2.04 | -2.34 | 2.04 |
| Other | - | - | - | - | - | - |
| Age | - | - | 0.01 | 0.12 | -0.00 | 0.12 |
| Education | - | - | -0.19 | 0.30 | -0.18 | 0.30 |
| Home intactness | | | | | | |
| Mother only | - | - | 1.60 | 1.75 | 1.48 | 1.75 |
| Father only | - | - | 2.57 | 2.25 | 2.24 | 1.24 |
| Mom and Dad | - | - | 1.93 | 1.72 | 1.76 | 1.72 |
| Other | - | - | - | - | - | - |

Appendix F: Multilevel models for change (MMC) in behavioral self-control with covariates *(continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Current residence | | | | | | |
| On campus | - | - | 1.32 | 1.58 | 1.31 | 1.58 |
| Off campus house | - | - | 0.65 | 1.58 | 0.57 | 1.52 |
| Off campus apt. | - | - | 1.35 | 1.52 | 1.29 | 1.52 |
| Other | - | - | - | - | - | - |
| Childhood residence | | | | | | |
| Farm | - | - | -0.51 | 1.32 | -0.56 | 1.32 |
| Rural | - | - | 0.00 | 0.72 | 0.04 | 0.73 |
| Small Town | - | - | 0.72 | 0.73 | 0.67 | 0.73 |
| Big Town | - | - | -0.01 | 0.53 | -0.01 | 0.53 |
| City | - | - | - | - | - | - |
| Random effects | St. Dev. | SE | St. Dev. | SE | St. Dev. | SE |
| Random variance in Intercept, $\sigma_0$ | 3.39 | 0.16 | 4.01 | 0.22 | 4.82 | 0.32 |
| Random variance in Wave, $\sigma_1$ | - | - | 0.33 | 0.02 | 0.93 | 0.11 |
| Random variance in Wave$^2$, $\sigma_2$ | - | - | - | - | 0.05 | 0.00 |
| Level 1 error variance, $\sigma_\varepsilon$ | 0.49 | 0.02 | 0.60 | 0.03 | 0.71 | .02 |
| *Rho*, $\rho$ | 0.49 | | 0.61 | | 0.72 | |
| *ln*(*likelihood*)[*df*] | -7380.96[3] | | -7083.84[23] | | -7036.56[27] | |
| *AIC* | 14767.92 | | 14213.70 | | 14127.12 | |
| *BIC* | 14785.60 | | 14348.53 | | 14285.41 | |

*b* = Unstandardized parameter estimate; SE = standard error; St. Dev. = standard deviation

* $p < .05$ (two-tailed tests)

## APPENDIX G: MULTILEVEL MODELS FOR CHANGE (MMC) IN ATTITUDINAL SELF-CONTROL WITH COVARIATES

Table G.1: Multilevel models for change (MMC) in attitudinal self-control with covariates

| | Unconditional means model | | Unconditional linear growth | | Unconditional non-linear growth | |
|---|---|---|---|---|---|---|
| | *b* | SE | *b* | SE | *b* | SE |
| Intercept, $\gamma_{00}$ | 28.92* | 0.25 | 17.93* | 3.53 | 17.31* | 3.49 |
| Wave, $\gamma_{10}$ | - | - | .07* | 0.55 | 0.42* | 0.09 |
| Wave$^2$, $\gamma_{20}$ | - | - | - | - | -0.02* | 0.00 |
| Sex | | | | | | |
| Male | - | - | -0.27 | 0.55 | -0.29 | 0.54 |
| Female | - | - | - | - | - | - |
| Race | | | | | | |
| White | - | - | -0.84 | 1.44 | -0.56 | 1.42 |
| Black | - | - | -0.22 | 1.53 | -0.08 | 1.51 |
| Hispanic | - | - | 0.22 | 2.20 | 0.46 | 2.17 |
| Asian | - | - | -2.60 | 2.09 | -2.02 | 2.06 |
| Other | - | - | - | - | - | - |
| Age | - | - | 0.31* | 0.13 | -0.27* | 0.12 |
| Education | - | - | 0.22 | 0.28 | 0.27 | 0.12 |
| Home intactness | | | | | | |
| Mother only | - | - | 2.42 | 1.83 | 2.02 | 1.82 |
| Father only | - | - | 3.02 | 2.35 | 2.82 | 2.32 |
| Mom and Dad | - | - | 2.54 | 1.80 | 2.10 | 1.79 |
| Other | - | - | - | - | - | - |

Appendix G: Multilevel models for change (MMC) in attitudinal self-control with covariates *(continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Current residence | | | | | | |
| On campus | - | - | 3.63* | 1.65 | 3.46* | 1.63 |
| Off campus house | - | - | 1.99 | 1.59 | 1.86 | 1.58 |
| Off campus apt | - | - | 2.48 | 1.59 | 2.23 | 1.57 |
| Other | - | - | - | - | - | - |
| Childhood residence | | | | | | |
| Farm | - | - | -0.10 | 1.38 | -0.49 | 1.37 |
| Rural | - | - | 0.69 | 0.75 | 0.70 | 0.74 |
| Small Town | - | - | -0.97 | 0.76 | -0.87 | 0.76 |
| Big Town | - | - | 0.06 | 0.55 | 0.03 | 0.55 |
| City | - | - | - | - | - | - |
| Random effects | St. Dev. | SE | St. Dev. | SE | St. Dev. | SE |
| Random variance in Intercept, $\sigma_0$ | 3.84 | 0.18 | 3.00 | 0.21 | 2.54 | 0.37 |
| Random variance in Wave, $\sigma_1$ | - | - | 0.31 | 0.03 | 0.52 | 0.18 |
| Random variance in Wave$^2$, $\sigma_2$ | - | - | - | - | 0.03 | 0.01 |
| Level 1 error variance, $\sigma_\varepsilon$ | 0.51 | 0.02 | 0.41 | 0.03 | 0.34 | .06 |
| *Rho*, $\rho$ | 0.51 | | 0.41 | | 0.35 | |
| *ln*(*likelihood*)[*df*] | -.7626.54[3] | | -7350.97[23] | | -7339.71[27] | |
| *AIC* | 15259.08 | | 14747.95 | | 14733.44 | |
| *BIC* | 15276.75 | | 14882.78 | | 14891.73 | |

*b* = Unstandardized parameter estimate; SE = standard error; St. Dev. = standard deviation

* $p < .05$ (two-tailed tests)

## APPENDIX H: VALIDITY CHECKS FOR SELF-CONTROL

Table H.1: Validity checks for self-control

| | b | SE | 95% Confidence Interval | | $R^2$ |
|---|---|---|---|---|---|
| Composite Self-Control | -.59* | .09 | -.77 | -.40 | .01 |
| Attitudinal Self-Control | -.20* | .06 | -.32 | -.08 | .00 |
| Behavioral Self-Control | -.77* | .09 | -.96 | -.58 | .02 |
| Attitudinal Self-Control | .14* | .01 | .11 | .16 | .05 |

*The top three models use crime as the dependent variable and the bottom model uses Behavioral Self-Control as the dependent variable.*

b = coefficient

SE = Standard Error

* = $p<.05$

Number of observations = 2671

Sample Size = 266

# APPENDIX I: BUDGET

Table I.1: Budget

| Budget Breakdown | Cost |
|---|---|
| SurveySwipe Software | 2000 |
| Compensation | 3280 |
| STATA Software | 275 |
| | $4890 |

## APPENDIX J: CODE FOR OBTAINING POSTSTRATIFIED MEANS OF SELF-CONTROL FOR SEX

Appendix J: Code for obtaining poststratified means of self-control for sex
(This code and analysis was written and done using R)

```
#---------------------------------------------------------------
# Run this script once for each wave of zTimpuls (Self-Control)
#---------------------------------------------------------------

# population distribution of sex
pop.nmales <- 15348
pop.nfemales <- 20133
pop.pmale <- pop.nmales/(pop.nmales+pop.nfemales)
pop.pmale

# tabulate sex distribution in the sample
table(df$sex,exclude=NULL)

#calculate mean of nonmissing observations
mean(df$zTimpuls2,na.rm=T)

# subset the data frame to purge all missing cases
df.nomissing <- subset(df,(sex==0 | sex==1) & !is.na(zTimpuls2))

# tabulate sex in purged (of missing cases) sample
table(df.nomissing$sex,exclude=NULL)

# put males and females in separate data frames
df.males <- subset(df.nomissing,sex==0)
df.females <- subset(df.nomissing,sex==1)

# count number of males in purged sample
n.males.sample <- nrow(df.males)
n.males.sample

# count number of females in purged sample
n.females.sample <- nrow(df.females)
n.females.sample

# calculate unweighted mean from purged sample
```

```
xbar.unweighted <- mean(df.nomissing$zTimpuls2)
xbar.unweighted


# calculate the mean for the males only
xbar.males <- mean(df.males$zTimpuls2)
xbar.males

# calculate the mean for the females only
xbar.females <- mean(df.females$zTimpuls2)
xbar.females

# calculate the post-stratified weighted mean
xbar.weighted <- pop.pmale*xbar.males+(1-pop.pmale)*xbar.females
xbar.weighted

#------------------------------------------------------------
# Use the values from the previous script to create the plot
#------------------------------------------------------------

# Create data for the unweighted means and the weighted means
uwm<-c(0.2698342, 0.2800124, 0.3722085, 0.4205736, 0.359187, 0.4273669,
0.4209744, 0.3838648, 0.4252036, 0.4240742, 0.375117, 0.43649)
wm<-c(0.2553789, 0.2765999, 0.3669757, 0.4146188, 0.3629621, 0.4274017,
0.4190244, 0.3755856, 0.4289753, 0.4235419, 0.3611808, 0.4434428)

# Give the chart file a name.
png(file = "poststratified_means.jpg")

# Plot the chart.
plot(uwm,type = "o",lty=2, xlab = "Wave", ylab = "Self-Control",
main = "Weighted and Unweighted Means")

lines(wm, type = "o", lty=1)

# Add a legend
legend(8, .3, legend=c("Weighted", "Unweighted"),
lty=1:2, cex=0.8)

# Add the sample sizes for each wave
text(x=1, y=.276, label="252")
```

```
text(x=2.3, y=.28, label="242", adj=0)
text(x=2.8, y=.37, label="237", adj=1)
text(x=3.8, y=.42, label="234", adj=1)
text(x=5.3, y=.36, label="226", adj=0)
text(x=5.8, y=.43, label="219", adj=1)
text(x=7.3, y=.42, label="221", adj=0)
text(x=8.3, y=.38, label="215", adj=0)
text(x=9.1, y=.432, label="210", adj=0)
text(x=10.2, y=.42, label="201", adj=0)
text(x=11.2, y=.37, label="192", adj=0)
text(x=11.8, y=.44, label="168", adj=1)

# Save the file.
dev.off()
```