A Dynamic Hobbesian Approach to Aggression and Self-Regulation

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G. John Geldhof

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* Co-Chair

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* Co-Chair

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Date Defended _____

The Thesis Committee for G. John Geldhof certifies

That this is the approved version of the following thesis:

A Dynamic Hobbesian Approach to Aggression and Self-Regulation

Committee:

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* Co-Chair

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* Co-Chair

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Date Approved _____

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## Abstract

Theory and metatheory combine to create the unique paradigm that influences how researchers interpret data and make hypotheses. By examining one combination of theory (dynamic systems) and metatheory (a Hobbesian outlook), this paper provides a solid theoretical framework for examining self-regulation, aggression, and resource control. This paradigm encourages researchers to consider the functions of aggression (reactive vs. instrumental) and forms of self-regulation (active vs. automatic) as unique constructs and generates hypotheses about their development and interaction. These hypotheses were tested in a sample of preschool children, and results showed that active regulation, automatic regulation, and aggression uniquely predict a significant portion of the variance in teacher-rated resource control.

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## PART I: THEORY

All research is driven by *a priori* assumptions about data and their interactions, even when the underlying philosophy is unacknowledged by a researcher. Some researchers (e.g., Eisenberg, Fabes, & Spinrad; Hawley, 2007) have made a point to discuss the importance of philosophy in their work, but the full impact of meta-theory may not be completely elucidated even when this occurs. In the present paper I argue that philosophy impacts researchers' interpretation of data in at least two ways, and I discuss how different philosophical perspectives can lead to qualitatively different interpretations of quantitative data.

To accomplish this task, I introduce two philosophical models (human nature according to Thomas Hobbes and dynamic systems as presented by Paul van Geert) and show how their confluence creates a unique set of predictions about aggression, self-regulation, and resource control. I then test these hypotheses using empirical data drawn from a sample of preschoolers and discuss the results as either supporting or contradicting the philosophical assumptions that gave them rise.

### Impact of Philosophy

A researcher's internal paradigm influences both his/her interpretation of data and the general direction of future research. These influences stem primarily from two separate (but not necessarily unrelated) sources that I will call 'meta-theory' and 'theory.' A researcher's meta-theory colors the qualitative way that he/she judges data and events, while the researcher's theories make specific hypotheses about the

observed data and how they are related. When a researcher observes a child aggressively work his/her way up the social ladder, that researcher's subjective impression (is the aggressive dominance good or bad for the child's social development) will be colored by his/her meta-theoretical assumptions about aggression and social dominance.

Theory, on the other hand, influences more than just the simple interpretation of an observed event. A researcher's theoretical perspective influences how that researcher views causality and gives certain cues greater salience over others. Attachment theorists share a common theory that infant-mother attachment plays a significant role in children's development. Attachment-oriented researchers therefore pay particular attention to attachment-related cues and will likely interpret observable behaviors in terms of those cues. A cognitive information-processing (IP) modeler, on the other hand, may not be as cognizant of attachment-related cues and may instead interpret behavior as the result of inner cognitive structures responding to environmental stimuli. Presenting two such researchers (one attachment-oriented and the other an IP theorist) with the same set of data will lead each researcher to a unique interpretation, each invoking different causal forces. The researchers' biases (I use this word in a completely neutral way) caused by their different theoretical approaches could lead these two researchers to then create different follow up studies, that might eventually lead to two completely different research agendas.

Theory is naturally informed by metatheory, but this does mean any given theory requires a specific metatheory, or vice versa. If the data discussed above

showed mean level differences in vocabulary across two groups of children, both researchers could assume that greater vocabulary is the preferred outcome. Similarly, two researchers could approach the same problem from a common theoretical perspective but for some reason disagree on whether greater vocabulary best serves the children being studied.

Philosophy biases research in predictable and often 'good' ways. Because it is impossible to simultaneously measure every potential variable on every member of a population across all points in time, specific hypotheses must be drawn about what variables are important and how they should interact to predict a non-trivial outcome. All hypotheses (and vicariously all lines of research) are continually influenced by philosophy on at least these two levels, and researchers should do well to understand the implications and impacts of philosophy on their own work. Doing this helps a research paradigm maintain optimal consistency while allowing the researcher to efficiently alter hypotheses in light of paradigm-contradictory evidence.

## An Intersection of Theory and Metatheory

In the next section I present the works of two philosophers (one is also a researcher) whose confluence will generate the unique hypotheses detailed below.

### *Metatheory*

The nature of man has long been disputed by philosophers, and philosophical dialogue has a continuing impact on psychological research even today. Just as Plato

used Socrates to represent the philosophy that gave rise to his theory of the forms,[1] I will use the face of Thomas Hobbes to represent the philosophical zeitgeist that influences my thinking. Hobbesian beliefs are not held by a majority of developmental researchers, so for the sake of comparison it is important to first present the predominant philosophy, which I give the face of Jean-Jacques Rousseau.

*Rousseau*

Rousseau's philosophy closely resembles the views held by a majority of developmental psychologists. The basic tenet of Rousseauian philosophy is that man (as a species) is by nature good and that individuals are destined to develop into perfectly moral creatures. Rousseau argues that modern society fails to optimally support men's development and thus corrupts their development. This corruption results in an unnatural life in which men must be educated (i.e., forced) into their places in society and taught to love the resources that this place can provide. This unnatural state leads all men to live unhappy and unfulfilled lives (Rousseau, 1762).

The Rousseauian tradition in developmental psychology assumes that children are basically 'good,' and that adverse environmental conditions consequently result in 'bad' behavior. Psychologists believe that by ameliorating this 'bad' environment, it becomes possible to vicariously promote 'good' behaviors such as self-restraint and prosociality while decreasing 'bad' behaviors such as selfishness and aggression. This

[1] Socrates never actually presented a written work, so details of his philosophy come only from others who referenced him. Plato, a student of the historical Socrates, made copious use of his teacher in his own writings, and it is probable that Plato distorted the historical Socrates as a means to optimally support his own philosophical agenda.

paradigm should therefore predict a negative relationship between self-regulation and aggression of all forms.

*Hobbes*

Hobbesian beliefs are often summarized by the oft-quoted saying that, "the life of man (is) solitary, poor, nasty, brutish, and short," (Hobbes, 1651). Hobbes depicts man as continually competing for the same (limited) resources, which leads to a no-holds-barred social environment where "might makes right" and "survival of the fittest" are the cold facts of reality. Innate ideas of 'justice' and 'injustice' do not exist within individuals; 'good' and 'evil' become relative to the person using the terms (Hobbes, 1651).

The theories of Freud (e.g., Freud, 1930, 1961) and Darwin (1859) are two influential accounts that can be considered "Hobbesian," but this approach seems less represented in modern developmental psychology[2]. The Hobbesian approach is undergoing a modern renaissance of sorts, however, and researchers such as Hawley (1999, 2002, 2003a, b, 2007), Nelson (2005), and Vaughn (Vaughn, Vollenwider, Bost, Azria-Evans, & Snider, 2003) have introduced accounts in which traditionally 'bad' behaviors such as aggression do not necessarily imply maladjustment. Hawley's (1999) resource control theory is especially Hobbesian, given its strong reliance on Darwinian natural selection and the necessity to compete for environmental resources. Other evolutionary models of psychological development also fall under

[2] But see modern evolutionary psychology (e.g., Buss, 2007)

the Hobbesian heading, and as this field grows, so too will the number of modern Hobbesian philosophers (even if they never cite Leviathan).

## *Theory*

### *Van Geert*

Fully understanding the psychological theories that influence one's work allows for a greater comprehension of data and a more facile integration of meta-theory. Dynamic systems theory as presented by Thelen and Smith (1998) and van Geert (2003) is one such account that has strongly influenced the hypotheses detailed below. This paper adopts a generalization of van Geert's (1991, 2003) model, which I next describe.

In his seminal publication, *A dynamic systems model of cognitive growth and language growth* (1991), van Geert introduced an ecological model of cognitive development that draws largely from dynamic systems theory as practiced in the fields of physics and chemistry[3]. The heart of this theory lies in Newtonian physics, particularly the ideas of entropy and anentropy. Per Newtonian physics, the universe is unable to obtain energy from an outside source, and is therefore considered a closed system with an innate tendency to move towards chaos (entropy). Locally organized energy will therefore move towards being diffuse, as van Geert exemplified by a cup of hot coffee sitting on his desk (2003). A fresh cup of coffee's heat energy is highly organized and is centrally located within the coffee itself. Over time,

[3] For further details of dynamic systems theory as applied to psychology, see Thelen and Smith's chapter in the *Handbook of Child Psychology* (1998).

however, the laws of entropy cause this heat to dissipate into the environment and the coffee becomes room temperature.

Van Geert argues that people are not closed systems, and that the laws of entropy apply to us in only a broad sense. In 1.4 trillion years it is likely that the atoms now centrally organized in my body will have dispersed across the universe, but for the time being I am an open system (able to bring in energy from the outside environment) and am therefore able to ward off the effects of entropy. This has dramatic implications for me as an individual and for my development. Without going into too much detail (if it isn't too late!), a cornerstone of van Geert's model lies in the idea that increasing the energy within an open system will cause that system to innately develop self-organizing properties. As a system, therefore, my body develops by way of interacting with the environment and by consolidating energy from it. Note that this assumption is not original to van Geert, but is common to many dynamic systems theories.

As an open system, I can be compared to other open systems by way of metaphor, as is presented by van Geert. In van Geert's metaphor, one first imagines a desert island. This island is relatively isolated from the outside world but is still an open system in that it acquires a constant flow of energy from the surrounding water currents, winds, sunlight, etc. Absolute isolation is impossible.

Occasionally, new species might even be introduced to this island; species may be blown off course by a storm or might accidentally float to the island on a piece of driftwood. Over time, many species will populate this island and an

ecosystem will begin to self-organize. This system will eventually obtain a point of relative equilibrium that, as van Geert specifies, is a function of the energy supplied to the island from the outside. Sunlight and rain will foster vegetation, which then supports further biological growth, etc.

Like this island, van Geert noted that I too am a semi-isolated system. I am a self-contained whole with internal cognitive structures that compete for the limited resources afforded to me by the outside world. Cognitive structures in this instance can be thought of as any behavior or behavior-governing rule that requires my attention and/or physical energy. Following this metaphor, van Geert considers both the island and me as systems that are fully imbedded in an external environment (the Earth when considering the island, my surroundings when considering me). The ecology of the island and I both consist of smaller pieces that actively compete for resources and grow until they reach an equilibrium point (called a point attractor) that is governed by the available resources and their relative competitive abilities. Growth occurs at the level of these pieces, not at the larger system level, thus van Geert calls these individual pieces ‘growers’.

To van Geert, these growers are the stuff of dynamic interaction and are intricately (completely) interwoven. The level of any grower at a specific point in time is fully dependant on the level of other (potentially all) growers in a system. Given this deep co-reliance, several forms of interaction become possible. Just as menarche does not appear in girls until a sufficient level of body fat is obtained, the development of one grower can be totally suppressed by the level of another grower

(called a control parameter). Two or more growers can also interact on the basis of limited resources by mutually supporting each other, or by way of resource-competition.

Like predator-prey models, these interactions are assumed to occur over time. Diseases that affect a prey population do not simultaneously affect an ecosystem's predator population, but instead the loss of prey decreases the maximally stable number of predators, leading the predator population to grow towards this level over time (note that in this case growth is negative). Similarly, a child does not immediately become more popular by becoming more prosocial towards his/her peers, but sustained prosociality over time may lead to increased popularity.

The deep interconnectivity of growers in van Geert's model reflects Thelen and Smith's (1998) concept of soft-assembly, and provides an interesting perspective for viewing the nature/nurture problem. Van Geert's systems are self-organized and only weakly separated from their environments; any given system is entirely balanced by self-organizational rules that optimally take advantage of the resources coming in from the outside world, and both internal and external changes can affect the level of several growers.

This becomes interesting in terms of the nature/nurture debate (and relevant to the hypotheses at hand) when one realizes that a system is not only embedded in/connected to its larger environment, but is in fact a self-organizing part of that environment. It is unfair to say that a person is connected to his/her environment just as one cannot truly say that a desert island is connected to the earth when in fact it is

PART of the earth. All humans have genes (nature), but these genes did not suddenly appear. Your genes (and mine) only exist because two environmental agents (gametes) interacted and formed an open system. As this system incorporated other parts of the environment it began to self-organize, eventually leading to the systems that you and I consider ourselves. This unity of person and environment lies at the core of Lerner's (2002) strong form of organism-environment interaction, and Van Geert (2003) describes this as one of the foundational tenets of dynamic systems theory. Thelen and Smith note that this idea comes from the biologically-derived systems theories implemented by Kuo, Schneirla, and their ilk (Thelen & Smith, 1998).

Just as organisms are embedded in a physical environment, it is also important to remember that all entities are embedded in time; my current state is fully dependant on my previous states and the changes that occurred between them. My development can therefore be seen as the summation of every physical and psychological change that I have experienced, each being the response to some environmental stimulus.

*Application*

The above discourse might seem unnecessarily abstract, but I again emphasize that a complete understanding of one's theoretical and metatheoretical roots is necessary to gain a full appreciation of both data and hypotheses. By providing this paper with a strong theoretical base, I am now able to describe how my personal theory and meta-theory combine to form a unique interpretation of the data that will be presented in later sections.

*The Self.* This paper examines two forms self-regulation in a sample of preschoolers. In studying self-regulation, most researchers make the assumption that an entity called the "self" exists and that this entity is somehow able to regulate an organism's behavior. Attempting to define the self often leads to ontological definitions[4] that provide little help to the enquiring researcher, thus jeopardizing the validity of self-regulation as a construct. What benefit arises from studying the effects of the self cannot be defined? The dynamic systems approach can provide some alleviation to this problem by forcing the researcher to draw a distinct boundary between what he/she considers the self and by forcing a definition of what it means for this self to regulate behavior.

To begin, I present a dynamic system that should be familiar to most people with an elementary education in physics: an external force applied to a ball. When force is applied to a ball, the ball gains momentum and rolls in the direction of the applied force until opposing forces (air resistance, the force of gravity, etc.) cause it to come to a stop some distance from where it started. The distance traveled is therefore a direct function of the amount of force initially applied and the amount of resistance the ball meets en route to its destination. Because this function is strictly mathematical, the same amount of force applied to another ball that meets exactly the same amount of resistance along its trajectory will stop rolling after travelling exactly the same distance as the first ball. The ball is an inactive agent in a fully deterministic system

[4] I.E., requiring a gestalt that is somehow greater than the sum of its parts. I use this term to emphasize the ambiguous nature of the self as it is commonly discussed

As previously described, the dynamic systems approach sees all organisms as open systems that are completely embedded in the larger environment. Biological organisms form at the confluence of two environmental agents (gametes) and grow from their interaction with environmental resources and constraints. As in the ball example, if two sets of identical gametes combined into two separate organisms, and these organisms developed in exactly identical environments, it is safe to assume that the two organisms would develop and behave in exactly the same manner. Given a specific starting point and specific environment, development and behavior can therefore be considered as completely determined by the system in which they occur. This concept is accepted in other dynamic systems theories (see Thelen & Smith, 1998), and eliminates the assumption that a qualitatively unique 'self' exists. An agentic self is not required when all behavior is predetermined.

If all organisms exist as part of a totally deterministic system, then all behaviors occur as a reaction to some aspect of the environment (which in its fully-embedded definition also includes genes), given a long enough time scale. This becomes troublesome for the study of self-regulation in that the self is no longer able to influence its own behavior, if it exists at all. Flipped on its ear, however, this approach eliminates the assumption of an undefinable self, allowing researchers to work within a more parsimonious framework that explains behavior in terms of a more artificial but researcher-defined definition of the self (and self-regulation).

The self can be defined as a gestalt system of growers that is completely embedded within a larger environment, which I call the "level one self." At this level,

all individuals have a nearly-ontological "self as a whole," and share this property with other types of systems. Van Geert's island has a self that is its ecology and our solar system has a self that is "the solar system," for instance. The self at this level self-regulates through its natural propensity to correct for system perturbations by responding to immediately salient stimuli.

Within a person, this level of the self can regulate in a variety of ways. A fatigued person will attempt to regulate his body through sleep, after injury a person's body will regenerate blood, and the anxious child might approach a novel situation cautiously because of the negative arousal that situation induces. In all of these situations, the self regulated in response to an immediately salient stimulus (fatigue, low blood count, novel situation), and followed the path of least resistance in doing so. The fatigued person did not try to become tired, nor did the anxious child go out of his way to become fearful.

As defined above, the level one self cannot account for all human behavior; not all behavior occurs as a relatively effortless response to an immediate stimulus. In order to account for these other behaviors, it becomes necessary to define a "level two self," that reacts specifically to distal stimuli. This level requires both a memory and the ability to anticipate future events/consequences, and represents the self that could be considered conscious. Humans have a level two self, lower order animals may or may not have a level two self, but ecosystems and galaxies likely do not.

This level of self is most likely the "self" commonly referred to in social psychology, and is able to regulate in ways that psychologists typically define as

"self-regulation." The level two self can implement previously successful strategies in anticipation of future rewards, even if other behaviors better serve the immediate environment or require less cognitive effort (path of least resistance).

The differentiation and interaction of the level one and level two selves is shown in Figure 1. This diagram shows that an organism begins as a strictly level one entity. This organism is able to perform basic bodily functions, but cannot interact with its environment in a conscious manner. Although I specify no specific mechanism, I hypothesize that development leads to the differentiation of the self, causing a level two self to emerge. The second panel (horizontal) of Figure 1 shows a differentiated organism in which level one behaviors are still controlled by the level one self, but is now capable of level two behaviors as well. This newly developed level two self is capable of learning strategies, consciously following rules, and actively controlling some functions of both the level one and level two selves (effortful control).

Progression down Figure 1 shows that functions of the level two self can become automatized, and therefore become a part of the level one self. In this figure, one specific strategy (strategy A) and the rule "don't kick others" have been consciously repeated several times, which has led to automatization. Automatization indicates that the rules no longer require the resources of the level two self, which leads to the extinction of consciously following this rule. Similarly, extinction can influence the behaviors of the level one self (here Strategy A) when those behaviors are no longer supported by the environment.

In sum, dynamic systems theorists should anticipate at least two levels of the self, each able to regulate the organism's behavior in its own unique way. A large amount of the work on self-regulation has specifically examined the ability of the level two self to regulate its behavior in response to distal stimuli, but it may be important to examine both levels of the self and how they are able to uniquely affect an organism's developmental outcomes. In the present paper I examine two forms of level one self-regulation (dispositional fearfulness and automized behaviors) and one form of level two self-regulation (active regulation) as correlated yet distinct constructs.

*Differentiation.* I expand van Geert's model by paying especial attention to one form of dynamic change, differentiation. In the parlance of developmental psychology, differentiation is the specialization of traits and/or skills that naturally arises due to maturational changes or social influences. A child might initially have a sucking reflex that serves the purposes of both self-comforting and nutrition-attainment. The pattern and rate of sucking that is optimal for each task differs, and through experience the infant's sucking reflex develops into separate nutritive and non-nutritive sucking patterns, leading to the differentiation of these sucking patterns. Similarly, a propose that the level two self differentiates from the level one self as an infant gains experience as an agentic entity and as he/she develops the abilities to both remember and anticipate events.

One aspect of differentiation most germane to examining aggression and self-regulation is that of automatization, as discussed above. Automatization is not

traditionally seen as a form of differentiation, but through automatization an initially conscious behavior differentiates into a non-consciously maintained baseline of behavior (part of the level one self) and a separate set of conscious acts that deviate from this baseline (level two self).

It might be argued that these two forms of behavior are not truly differentiated but are really concurrent subsets of the same single behavior. This appears not to be the case. Work by Bargh and colleagues indicates that automatized behaviors can, as part of their normal functioning, form unconscious goals that are not necessarily part of that person's conscious desires. Fitzsimmons and Bargh (2004) discuss this in terms of a dieter who is presented with a piece of cake. If the dieter has internalized dieting behavior, the unconscious goal of dieting might interfere with the conscious desire to eat the cake. Conscious and automatized behaviors therefore may have a similar super-structure (e.g., goal initiation), but may work towards separate goals.

Both aggressive and self-regulated behaviors can exist at both levels of the self, indicating some necessary degree of differentiation within these constructs. Each form of behavior might lead to different effects, and it is necessary to examine each separately. The constructs will not exist orthogonal to each other, and it is also important to understand the co-relationships between a behavior's conscious and non-conscious forms. Differentiation of these constructs is discussed later in this paper.

### *Dynamic Systems and the Hobbesian Metatheory: An Intersection*

A unique developmental paradigm arises when Hobbesian meta-theory combines with a theory of dynamic interaction. I hypothesize that development is

largely (but not solely) due to differentiation, which itself is caused by environmental feedback that is the result of successive attempts to obtain and control the limited resources afforded by the environment. In drawing from her own evolutionary paradigm, Hawley (1999) used a similar theoretical approach to hypothesize that prosocial and coercive strategies of resource control will appear undifferentiated in very young children. Over time these two strategies differentiate, with different types of children differentially implementing or abstaining from particular strategies. Although this particular hypothesis does not fully agree with the interpretation provided below, it provides an excellent example of how Hobbesian meta-theory can combine with a dynamic theory of development and lead to empirically testable hypotheses. Predicting such relationships, especially how they change over time, requires a full understanding of each construct examined. The next section describes my interpretation of the constructs as it is impacted by the both theory and meta-theory.

## Construct Interpretation

The below interpretations and hypotheses reflect my own flavor of the Hobbesian/dynamic systems interaction in which especial emphasis is placed on the differentiation of behaviors through environmentally supported automatization. I interpret constructs as being co-reliant within any given individual such that the observed level of any specific behavior is supported by the presence of some behaviors while being hindered by the presence of others. The influence of dynamic systems theory can also be seen in the direction of my hypothesized

interrelationships. As will be described below, level one self-regulation behaviors are expected to positively correlate, although this is not necessarily expected for self-regulation behaviors that occur at different levels of the self.

I also hypothesize that the constructs interact in meaningful ways that, per the Hobbesian meta-theory, should optimally result in resource acquisition. In this paradigm, children's behavior is neither innately good nor bad but is rather the simple (mathematical) result of resource-acquisition attempts. These behaviors are judged by outside parties in agreement with a socially constructed norm of behavior, and this subjective judgment determines if the child's behavior is supported or discouraged by the environment.

### *Resource Control*

I introduce the concept of resource control because it fits squarely into the Hobbesian meta-theory as the primary outcome by which other behaviors should be judged. The beneficial and/or maladaptive effects of self-regulation and aggression can therefore be gauged by how they each affect resource control. To fully understand the pros and cons of each, however, first requires a definition of resource.

Humans, like all animals, are required to obtain and utilize environmental resources in order to thrive. Humans must therefore compete for these resources either individually or as a group. Hawley (1999, 2002) has taken these principles into the psychological domain, describing social behavior (prosociality and aggression) as acts geared towards the presumably optimal attainment of the material, social, and informational resources that optimally support an individual's reproductive ability.

I adopt Hawley's definition of resources, and expand it to include any thing (physical or not) that ultimately leads to an organism's health and/or reproductive success or is perceived to lead to such by the individual. This definition makes one distinction over many other definitions of 'resource,' in that it expands resources to include those things that might not be acquired in the service of physical needs. As evidenced by Harlow (1958) and the plethora of studies performed on Romanian orphans (e.g., O'Connor et al., 2000), social contact and affection are certainly required for optimal development. The importance of these resources goes far beyond the physical needs associated with them.

As (indirectly) described by Hawley, resources can come in either direct or indirect forms. Direct resources are likely to be what one initially perceives as a 'resource,' such as something that meets one of the basic human needs (i.e., food, water, shelter, etc.) described by Maslow (1943). These resources can also be garnered indirectly by either physical or social means. One person might indirectly gain access to food by owning another resource (land) on which to grow it. Another individual might gain the same resource (food) by being the close confidant of a powerful leader (i.e., the leader provides his/her friend with food). In either instance, the end-resource is obtained indirectly by the control of another resource.

Resources can also be much more mundane. When I purchase a wide-screen television, that object becomes a resource through which I can indirectly obtain other resources. If I am especially fond of movies, the television affords me the chance to

relax[5], relaxation being a resource in that the unchecked growth of stress can lead to numerous hazards to my personal well being.

The T.V. also affords me the means to access social resources. By owning the largest T.V. in my social group, I might be afforded status, which then affords me the attention of my peers. This T.V. might also provide me with the opportunity to have a friend come to my house to watch a game. This invitation might be reciprocated by my friend inviting me over for dinner on another night. In this instance, the television has allowed me to access both social contact and food. Such resources exist as part of a deeply interconnected and multi-faceted environment, and any particular resource may hold multiple roles (e.g., direct means of alleviating one need and simultaneously being an indirect way to meet others).

As the example of the television makes clear, effective resource management can be one means to obtain new resources. In the long run, had I spent my T.V. money on a less effective resource, say a case of champagne that I drank by myself, my investment would not have provided the opportunity to gain nearly as many resources.

Despite the benefits of effective resource management, most resources are obtained by what Hawley (1999) calls prosocial and coercive strategies of resource control. Prosocial control can be seen in the above television example in that the T.V. provided me with opportunities to acquire other resources in a prosocial manner (like

[5] I argue that relaxation is an energy efficient behavior that is both physically and psychologically beneficial to an organism. Because relaxation requires some amount of time, it can only be afforded by those organisms with enough resources to meet their basic needs.

having a friend over). The alternative to prosocial control, coercive control, can by and large be thought of as aggression (relational or otherwise, see below). If I rob my neighbor, I am coercively controlling the resources that were at one point his. A young child might similarly obtain social resources through intimidation.

Below I will argue that prosociality is a subset of self-regulation, meaning that resource control is particularly germane to the present issues of aggression and self-regulation. This interpretation thrives in a Hobbesian environment and indicates that all willful behaviors are likely attempts at attaining resources of one type or another. As stated previously, my Hobbesian perspective places resource control as the primary dependent variable in my analyses.

### *Aggression*

Aggression encompasses those acts aimed at harming others (Parke & Slaby, 1983), and can be dissected in a variety of ways; aggression can occur directly (overt aggression) or through the social group (relational aggression; Crick, Casas, & Mosher, 1997; Crick & Grotpeter, 1995), for instance. The present paper examines one approach to aggression that focuses primarily on the intent of aggressor (reactive vs. instrumental) as described by Little and colleagues (Little, Jones, Henrich, & Hawley, 2003). In this line of research, reactive aggression occurs as a heat-of-the-moment response to provocation (but see Hawley, Little, Geldhof, & Howard, in prep), while instrumental aggression represents the well-planned means to some particular end.

Much of the current literature concerning aggression has deep (but often unacknowledged) roots in the Rousseauian tradition. Childhood aggression is seen as suboptimal and early attempts to remedy aggressive behavior are often made. Contrary to this common interpretation, my hypotheses examine aggressive behavior from a morally neutral position, reflecting the works of Hobbesian theorists such as Hawley.

Aggression usually occurs as a social phenomenon (Dodge, Coie, & Lynam, 2006), meaning that social interpretations of aggression are almost inevitable. Qualitative interpretations of aggression might change over time, and the degree of environmental reinforcement provided to acts of aggression will vary by context. To illustrate, imagine that you witness an act of aggression on a playground. One child pushes another. If the pusher is making an attempt to dominate another peer, then you might deem this behavior inappropriate. In the pusher is retaliating against a bully's taunts, your judgment might be less severe. In both of these examples, the peer context also mediates whether the pusher is supported or rejected for the aggressive action. If the child exerting dominance over another is a continual bully, then this instance of aggression is likely to result in peer rejection. But if the pushing child is generally well liked, his or her peers might 'let this one slide,' meaning that the child will not be subject to rejection while simultaneously benefiting from the social dominance over the pushed peer.

My approach states that aggression is subject to the forces of differentiation and automatization. I propose that infantile aggression is primarily driven by

children's immediate physical and emotional needs, and that by the age of two this aggression begins to occur as the result of habitual behavior patterns. These patterns of aggression develop into fully distinguishable resource-control mechanisms by the time a child is five (CH agg p. 725), indicating that all aggression is likely reactive at first, at first, with distinguishable reactive and instrumental forms developing later.

This approach is very much in line with Vitaro and Brendgens's (2005) sequential development model of aggression. In their model, Vitaro and Brendgen hypothesize that infant temperament initially gives rise to reactive aggression, which then interacts with a psychosocial environment that either does or does not foster instrumental aggressiveness. The authors exemplify this progression with a hypothetical child who is born with certain characteristics that lead him to react to frustrating situations with aggression. If this child's initially reactive outbursts are reinforced (say the child throws a fit because he wants a cookie, which results in his parents giving him a cookie to satiate him), it is possible that the child will associate aggression with instrumental gains, eventually leading to an instrumentally aggressive child (Vitaro & Brendgen, 2005). In this instance, the child's interaction with his parents moderates the differentiation of temperamentally reactive behavior into reactive and instrumental forms.

This hypothesis also conforms to the common linking of reactive aggression with the frustration-aggression hypothesis and linking instrumental aggression to social learning theory (see Dodge, Lochman, Harnish, Bates, & Pettit, 1997). In the above example, the child can be thought of as being temperamentally prone to

frustration that then leads to reactive outbursts. These outbursts are supported by the environment, and the child then learns that some forms of aggression can result in material gains. This leads to an increased use of instrumental aggression. Instrumental aggression can also arise from the observed reinforcement of others' aggression, further supporting the social learning theory link.

If instrumental aggression does arise from initially reactive acts, then it is important to examine the social effects of this differentiation. If a child progresses from initially unbridled acts of reactive aggression to aggression that is more selective and instrumental, this implies that some agent has caused the child's behavior to change. It is possible that the social acceptance of reactive aggression wanes as children grow older, which would cause socially-sensitive children to shy away from its implementation and favor the use of more selective and instrumental acts of aggression (see also Hawley, 1999).

Alternatively, maturational changes within the individual might lead to a deeper understanding of causality, which then affects the way children interact with their environment. This qualitative shift in interaction and reinforcement might lead to an increase in more prolonged/instrumental forms of aggression, which could mean either an actual or a perceived differentiation of the two forms. Prolonging aggression requires at least some degree of regulation from either the level one or level two selves, and its development reflects the dynamic systems approach.

### *Self-Regulation*

Self-regulation has been defined as "any efforts by the human self to alter any of its own inner states or responses," (Vohs & Baumeister, 2004, p. 2), and is commonly seen as the ability to actively continue or inhibit a behavior in the face of negative arousal. I interpret this as an active process of the level two self. This form of self-regulation is often measured in children by the ability to delay gratification (i.e., Mischel, Shoda, & Rodriguez, 1989), follow directions in the absence of an experimenter/parent (Kochanska, Coy, & Murray, 2001), the ability to sustain attention, (for example, National Institute of Child Health and Human Development Early Child Care Research Network 2003 Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956) or by measuring general impulsivity/hyperactivity (see for instance, Barkley, 1997; National Institute of Child Health and Human Development Early Child Care Research Network 2003).

Actively regulating our behavior allows humans to modulate reactivity (Rothbart, Ellis, & Posner, 2004) and to optimize resource acquisition through persistence (Hawley & Little, 1999) or waiting (Mischel et al., 1989). Self-regulation interacts with motivation to cause goal-directed behavior (Ryan & Deci, 2002), and can influence how well plans are adhered to. Active behavioral regulation allows humans to ignore distracting stimuli (Eisenberg, Smith, Sadovsky, & Spinrad, 2004) and modulate our emotions in social situations (Eisenberg, Wentzel, & Harris, 1998 ).

Self-regulation at this level necessitates that the level two self has developed. As discussed above, this level of the self is proposed to differentiate from the level

one self early in life, perhaps due to the influences of early temperament. Once differentiated, the level two self then actively regulates behavior which itself re-differentiates into active and automatized forms of regulation. Through this mechanism, behaviors actively regulated by the level two self can eventually become a part of automatic behaviors of the level one self. These automatized behaviors form a construct that Bargh and colleagues call automatic self-regulation (Fitzsimmons & Bargh, 2004).

Behaviors that result from this automatic regulation are considered regulated in the sense that they help a person stay within the boundaries of socially accepted behavior but do not require active motivation to maintain (they have become automatized). This form of regulation can be thought of as subconscious adherence to social norms due to socialization, internalizing and following common, rules for example, and I expect that most acts of non-instrumental (i.e., without the specific intention of receiving personal benefit) prosociality falls into this category of behaviors.

Other prosocial behaviors might also be the result of automatizing actively regulated behaviors. Following new rules, for instance, requires an initial degree of active regulation (see Kochanska, 1994). As a rule is internalized, however, adherence to it should require less and less of the child's attentional and regulatory resources, eventually resulting is full internalization. At this point, more conscious effort (self-regulation) should be required to break the rule than to follow it (for an interesting discussion of counter-normative behavior requiring self-regulation in

adults, see Vohs, Baumeister & Ciarocco, 2005). [6] Bargh similarly used Shifrin and Schneider's (1977) model of automatization to hypothesize that repetition of actively regulated behaviors[7] can lead to their automatization (goals; see Wegner & Bargh, 1998 for a review). Although these automatized behaviors initially required a certain degree of active regulation, their implementation becomes automatic, leading to automatic self-regulation (Fitzsimmons & Bargh, 2004).

Social norms have often been described in terms of automatic regulation. Norms are related to intuitive and reflexive behaviors (Haidt, 2001), are seen to regulate behavior while bypassing consciousness (Bargh, 1990; Cohen, 1997), and can become part of an individual's personal motive system (Hoffman 1991a,b, 2000). The morality-as-automatic regulation assumption has played an important part in many classic theories such as those of Freud and Skinner (see Turiel, 2006).

Work done by Kochanska and colleagues also examines the role that internalized regulation plays in the development of an internalized conscience (which regulates behavior through the level one self). In her work, morality is defined as obtaining a conscience that regulates behavior to society's norms (Kochanska 1993, see also Thompson, Meyer, & McGinley, 2006), with conscience arising from a

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[6] In their study, Vohs, Baumeister & Ciarocco (2005) examined the ego-depleting (i.e., self-regulatory energy reducing) effects of presenting oneself in a counter-normative way. When subjects were asked to behave atypically, performance on a later self-regulatory task was poorer than the performance of controls. The authors argue that self-presentation in non-normative ways requires constant psychological monitoring and therefore self-regulation. Self-presentation that is in accordance to a subject's baseline behaviors does not require monitoring/regulation and thus does not result in ego-depletion.

[7] N.B. that Gollwitzer's (Gollwitzer, 1993, 1999; Gollwitzer & Brandsatter, 1997) work concerning implementation intentions hypothesizes that automatization may occur due to hypothesizing the details of goal attainment such as how, where, when, etc. instead of though the actual implementation of these acts. It is not clear, however if regulated behaviors that arise from such implementation intentions are due to active or automated processes.

mixture of self-regulation, guilt, and negative emotions such as fear (Kochanska, 1993; Kochanska & Aksan, 2006). She and her colleagues have found that self-regulation is concurrently related to a child's level of conscience (Kochanska, Murray, & Coy, 1997) and that it correlates highly with future levels of conscience (Kochanska et al., 1997 ; Kochanska & Knaack, 2003). This supports the idea that automatic self-regulation arises from actively regulated behaviors. Children who actively regulate their behavior the most are likely to show higher levels of automatic self-regulation both concurrently and longitudinally.

These automated behaviors act as a new behavioral baseline (akin to the level one self as described above) from which transgressions must actively depart (conscious regulation by the level two self). It is therefore safe to assume that the active and automatic self-regulation will be positively correlated when a behavior is freshly automated, but that this relationship will weaken over time. The degree to which a behavior adheres to social norms does not depend on a person's current ability to actively regulate, but rather on the level of regulation present when the behavior was most recently automated.

### *Fearfulness*

General fearfulness is a means through which the level one self can regulate behavior. Fearfulness is one of the human infant's first regulatory mechanisms (Rothbart et al., 2004), and continues to inhibit behavior throughout development (i.e., fearful inhibition, Aksan, Kochanska, 2004; see also Aronfeed, 1961; Freud, 1961; Derryberry & Rothbart, 1997; Kimonis, 2006; but see Kochanska 1997). Some

researchers have even gone so far as to hypothesize that behavior is regulated largely due to fear.

This fear-as-regulation view has come into question. Children with secure attachments and warm, caring parents (who they should NOT fear) have been seen to develop high levels of active self-regulation (Calkins & Johnson, 1998; Gilliom, shaw, Beck, Schonberg, & Lukon, 2002; Olson, Bates, & Bales, 1990), and in children as young as six, concurrent measures of fearfulness and inhibitory control (regulation by the level two self) have been shown to differentiate in factor analytic studies (Ahadi, Rothbart, & Ye, 1993; Rothbart, Ahadi, Hershey & Fisher, 2001 but see Aksan & Kochanska, 2004). Fearful inhibition has been seen to load onto a factor of negative emotionality while inhibitory control tends to load on a factor of effortful control (Ahadi,et al., 1993; Rothbart et al., 2001). Different brain areas are also implicated in the implementation of these behavioral regulators, further indicating their separateness. Activity in the hippocampus (conditioned fear signals) and potentially the amygdala is related to fearful inhibition (Derryberry & Rothbart, 1997) while activity in the anterior cingulate is related to inhibitory control (Derryberry & Rothbart, 1997; Durston, Thomas, Yang, Uluğ, Zimmerman, & Casey, 2002).

Kochanska, however, proposed that early conscience (morally regulated behavior) results from both fearfulness and effortful control in toddlers, but primarily effortful control later in childhood (Kochanska, 1997; Kochanska, Murray, Harlan, 2000). The relationship with effortful control may be due to the automatization of

actively regulated behaviors, meaning that conscience arises from two different types of behavioral regulation by the level one self.

I interpret fearfulness as a general inhibition away from environment-exploring actions and an aspect of behavior that should inhibit attempts to control new resources. Further, children may follow rules and display behaviors that appear to be internalized, but do so simply out of fear. Because rule-internalization and fearfulness may appear to be similar superficially, I argue that any exploration of automated self-regulation should control for the effects of fearfulness. Controlling for the dual influences on other-perceived automatic regulation will allow for greater accuracy in both hypothesis generation and testing, as will be illustrated below.

## PART II: HYPOTHESES AND THEIR SUPPORT

### Hypotheses

As stated previously, the first part of this paper provided an overview of two theoretical paradigms from which hypotheses could be drawn. Here I present several hypotheses concerning the interrelationships between aggression, self-regulation, fearfulness, and resource control, with each hypothesis followed by a brief discussion of its theoretical underpinnings[8]. Following the theoretical discussion of the hypotheses, I then provide supporting evidence from the literature.

#### *Relating Aggression and Self-Regulation*

As discussed above, I view both active regulation and instrumental aggression as forms of resource-directed behavior in accordance with the Hobbesian metatheory.

[8] All tested hypotheses are presented in the form of structural models in Figures 2 and 3. Note that only hypotheses involving a unidimensional aggression construct are represented.

I therefore anticipate that these two constructs will be positively related. Reactive aggression is by its very nature uncontrolled reaction to provocation, and I hypothesize that it will be negatively related to active self-regulation. Social/maturational forces may not have led to the (actual or perceived) differentiation of instrumental and reactive aggression within this sample. In the case of a non-differentiated aggression construct I expect that non-differentiated aggression will serve the role of a resource-acquisition mechanism. If differentiation is not the case, then reactively aggressive behavior will not be universally perceived as an uncontrolled act, meaning that aggression will not result in the same negative consequences seen in older children (see Card & Little, 2006).

Because the unidimensional aggression construct is expected to positively predict resource control, it should vicariously, but not meaningfully, be related to active regulation. Resource control will act as a full mediator between the unidimensional aggression construct and active self-regulation.

Because most internalized rules of behavior prohibit acts of aggression, I further predict that automatic regulation is negatively related to instrumental and reactive aggression, as well as to a non-differentiated aggression construct.

### *Predicting Resource Control*

Instrumental aggression and active regulation are both hypothesized to be active resource controlling behaviors, and should therefore positively (and independently) predict general resource control. In the instance where reactive and instrumental forms of aggression have differentiated, I expect that reactive aggression

will be seen negatively by the peer group and will therefore be negatively related to resource control. If differentiation has not occurred, then I expect that social forces will not have yet selected out reactively aggressive behavior meaning that aggression will have full resource-acquisition capabilities while being untethered by the negative social consequences of aggression. This unidimensional aggression construct will positively predict resource control.

### *The Mediating Effect of Self-Regulation*

While self-regulation and aggression are thought to have independent effects on resource control, at least some of the positive effect of instrumental aggression and a great deal of the negative effect of reactive aggression is expected to be due to variance in active regulation. Active regulation is expected to (partially) positively mediate the relationship between instrumental aggression and resource control, while negatively mediating the effect of reactive aggression on resource control. These constructs are expected to be largely orthogonal before the differentiation of aggression, and if this is the case, no meditated path is expected.

### *Fearfulness as a Covariate*

Because I predict that fearfulness will limit resource-directed behavior, I predict that it will be negatively related to resource control, aggression and active self-regulation. Both fearfulness and automatic self regulation are implemented by the level one self, and I further predict that fearfulness will be unintentionally mistaken for automatic regulation by observers. This confluence will lead to a statistical (but not meaningful) positive relationship between these two constructs.

## Empirical Support

The hypotheses generated in the previous section do not stand without empirical support. Although the simultaneous relationships between resource control, self-regulation, and aggression has not been directly studied in the past, this section of the paper discusses the hypotheses in terms of previous relevant empirical findings.

### *Aggression*

The majority of the current aggression literature has deep (but often unacknowledged) roots in the Rousseauian tradition; childhood aggression is viewed as suboptimal and attempts to remedy aggressive behavior are common place. This literature has accordingly found that aggression is related to concurrent and longitudinal peer rejection (Crick, 2006; Keane & Calkins, 2004; Wood, 2002), and is positively related to conflict in friendships (Sebanc, 2003). Aggressive-withdrawn preschoolers have reported being more lonely, victimized, and disliked than their peers (Ladd & Burgess, 1999), and preschoolers' aggression negatively predicts the likelihood of being a recipient of peers' future acts of prosociality (Persson, 2005).

To the Hobbesian, these findings only tell part of the story. Examining the dual effects of instrumental and reactive aggression may provide new insights into the effects aggressive behavior. Instrumental aggression has the *a priori* purpose of benefiting the aggressor and it has been noted that aggression can lead to physical rewards, social rewards, induce intrinsic pleasure (e.g., revenge; DeQuervain, 2004), and can reduce aversive treatment by others (Bandura, 1983). Aggressive behavior may also act as part of a larger social communication system (Tedesci & Felson,

1994) and might mediate some social learning processes by teaching children their strengths, their weaknesses, social dynamics, and theory of mind (Smith, 2007).

These socially beneficial aspects of aggression might explain why some aggressive children play central roles in childhood social groups (see Hawley 2002, 2003a, b). Hawley (1999, 2007) has even hypothesized that social dominance forms at the confluence between aggression and social skills.

Selectively beneficial aggression can also be used to explain Pellegrini and colleagues' findings related to teacher-rated aggressiveness and dominance, observed aggressiveness, and the amount of time that children's observed aggression results in a "win" for that child (i.e., the child came out ahead; Pellegrini et al., 2007). In this study, neither observed nor teacher-rated aggression predicted ratings of social dominance, although the number of aggressive "wins" did. Winning was positively associated with teacher-rated social dominance.

Further differentiating the two functions of aggression, instrumental aggression has been related to normal patterns of adjustment while reactive aggression seems to correlate with poor adjustment (Little, Brauner, Jones, Nock, & Hawley, 2003, see also Card & Little, 2006). Instrumental aggression may therefore be single handedly driving the positive relationships discussed above. Given this possibility, I predict that instrumental aggression will positively predict resource control, while reactive aggression negatively predicts it.

## *Self-Regulation*

### *Self-Regulation and Aggression*

Self-regulation and antisocial behavior (such as aggression) have been seen as antithetical to each other (e.g., Quay, 1979). Accordingly, research has shows that antisocial behaviors (including aggression and delinquency) correlate negatively with self-regulatory functioning (Floyd & Kirby, 2001; Keown & Woodard, 2006; Lynam & Henry, 2001; Seguin, Pihl, Harden, Tremblay, & Boulerice 1995). This observed relationship may also be causal, as the depletion of regulatory energy has been shown to increase the likelihood of aggression in adults (Dewall, Baumeister, Stillman, & Gaillot, 2007).

These observed relationships are qualified by the fact that the studies discussed did not examine the unique forms and/or functions of self-regulation or aggression. From these studies, one can only generalize that some type of aggression is likely negatively related to some unspecified type of self-regulation. The previously described relationship therefore may not hold when the unique types of aggression and self-regulation are examined. Instrumentally aggressive children even displayed greater active self-regulation (frustration tolerance) than reactively aggressive children in one study (Little, Brauner, et al., 2003). Although more literature specifically examining the unique aspects of self-regulation and aggression is needed, this finding does support the hypotheses that active self-regulation should be both positively related to instrumental aggression and negatively related to reactive aggression.

Also to note, I found no research specifically examining automatic self-regulation (internalization) and its relationship with aggression. As described above, automatic regulation is expected to result in the internalization of social norms, and since very few norms allow for public aggression, aggression is expected to be negatively related to automatic self-regulation.

*Self-Regulation and Resource Control*

Active self-regulation may be especially related to resource control. In preschoolers, active self-regulation is positively related to indicators of social resource control such as social preference (Smith, 2001; Smith & Walden, 2001), popularity (Raver, Blackburn, Bancroft, & Torp, 1999), and social competence[9] (Diener & Kim, 2004; Raver et al., 1999). Dysregulation (hyperactivity) is likewise related to peer-rejection (Maszk, Eisenberg, & Guthrie, 1999; Wood, 2002) and other negative social outcomes (e.g., Kyrios & Prior, 1990), indicating a negative relationship between dysregulation and some skills and outcomes associated with social resource control.

Because active self-regulation should positively predict resource control while being positively correlated with instrumental aggression and negatively correlated with reactive aggression, I expect that active self-regulation will partially mediate the pathways between both types of aggression and resource control. Appendix A provides a justification for the appropriateness of examining these measures in preschoolers.

[9] Although social competence is not directly a resource, it provides the means through which other resources can be acquired

*Fearfulness and Self-Regulation*

As stated above, fearfulness is one of the human infant's first regulatory mechanisms (Rothbart, et al. 2004), and may be mistaken for a child's internalization of rules (automatic self-regulation) later in life. Fearfulness and active self-regulation do not appear to be related, however, as they load onto different factors (Ahadi et al. 1993; Rothbart et al., 2001 but see Aksan & Kochanska, 2004) and involve activity in different brain areas (Derryberry & Rothbart, 1997; Durston et al., 2002).

## Philosophy

Although much of the evidence supporting my hypotheses is presented in an atheoretical manner, the reader should not take this as an indication that theory and metatheory are any less important now than when they were initially presented. The empirical evidence that I present was not necessarily conducted with the same theoretical intentions that I promote, but rather this evidence is provided as an external validation that my theoretically justified hypotheses are plausible. The empirical studies that I cite should be taken as supporting my position, which itself is the result of a paradigm in which constructs arise, differentiate and interact in a dynamic way that optimally serves the organism in a Hobbesian sense (promotes individual resource attainment or the illusion thereof).

## Conclusion

A researcher's personal philosophy (meta-theory) and the theoretical tradition of his/her research agenda both impact how data are interpreted and what hypotheses are made. These two sources of philosophical influence interact dynamically, and

understanding any particular philosophical influence in isolation is inadequate. Like all aspects of human functioning, philosophy does not exist in a static or sterile environment. Philosophy involves a dynamic interaction of individual assumptions that grow, compete, and depend on each other. By understanding the interaction of these assumptions researchers can consistently interpret data within their own paradigm and appropriately alter their research agendas in light of hypothesis-contradictory evidence.

Above, I presented a detailed account of two of the primary philosophical and theoretical influences on my own mode of thinking about data, then used the interaction of these two to generate theoretically solid hypotheses regarding the natures of and interaction between aggression and self-regulation.

Based on the above discussion, I arrive at the following hypotheses: (a) that aggression and self-regulation are not by necessity negatively related, and that certain aspects may be positively related while others are correlated negatively, (b) that both active self-regulation and aggression will positively predict the outcome variable of resource control, (c) that active self-regulation will partially mediate the effects of differentiated aggression constructs on resource control, (d) that fearfulness will be antithetical to resource-acquisition and will therefore be negatively related to resource control, active regulation, and to aggressiveness in general, and an ancillary hypothesis, (e) that fearfulness will likely be mistaken for automatic regulation, creating a degree of (positive) confluence between these two constructs.

# PART III: TESTING THE HYPOTHESES

## Methods

### *Participants*

Participants consisted of 315 children (Mean age 4.56 years, *SD* = 0.84) from 19 preschool classrooms in Lawrence, Kansas and New Haven, Connecticut. At least one teacher (total *n* = 24) from each child's classroom provided information about the children. Children's gender was equally distributed (53% female, *n* = 167), and of the children, 66% were Caucasian (*n* = 209), 18% of African descent (*n* = 58), 8% of Asian descent (*n* = 24), 7% Hispanic (*n* = 22), and < 1% were of other or mixed race (*n* = 2). Parental consent to participate in this study was provided for each child. Additionally, each child was required to assent to participation at the time of data collection.

### *Measures*

Data gathered for this study were a subset of a larger battery of measures aimed at exploring preschool children's social problem solving abilities, moral affect/cognition, social interactions, personality traits, and physical attractiveness. The present paper is a secondary analysis of these data. All measures used in the present study were rated by one of the teachers in each child's classroom, with all measures except the dominance hierarchy (see below) being rated on a seven-point (1-7) likert-type scale, with higher scores indicating that the items were more reflective of a child. For measures containing multiple items, items were standardized by either classroom or across the entire sample as warranted, and the post-

standardization mean was taken as a scale score. Where applicable (i.e., a scale was not broken into parcels), these scores were again standardized across the sample, and were taken to be the overall score for their respective measures.

*Teacher-Rated Resource Control*

Peer ratings of children's resource control are not feasible for the age group studied, meaning that teacher ratings provide the best non-observational estimate of a child's actual resource control. Although this presents a deficit in examining a child's true access to resources, teacher ratings have been shown to positively correlate with observational measures of resource control (Hawley, 2002). Teachers rated each child's ability to control resources using two scales. First, a six-item scale developed by Hawley (2003b) examined general resource control with items such as, "This child usually gets what s/he wants when with peers," and "This child usually gets the best roles in games when with peers." These items tap into a child's ability to navigate the social world while obtaining what s/he desires.

Teachers also scored each child's relative degree of resource control by rank-ordering their students into a dominance hierarchy. In this hierarchy, a score of one indicated the most dominant student in the classroom ("who prevails (wins) most,") while a score of *n* represented the least dominant child ("who prevails the least,") where *n* is the number of children in the classroom. These hierarchies were standardized by classroom and reverse-coded so that a higher score would indicate higher social dominance.

*Aggression*

Little, Jones, et al. (2003) developed a measure of aggression that examines two forms (overt and relational) and two functions (instrumental and reactive) of aggressive behavior. Using a modified version of Little et al.'s aggression questionnaire, teachers rated each child's aggression in all four possible dimensions (two functions in each of two forms). Because of the nature of the current study, only the functional aspects of aggression were examined (i.e., reactive and instrumental). Variance related to general aggressiveness was partialled out, resulting in twelve items that represent pure reactive or instrumental aggression and are independent of a child's overall aggressiveness.

*Self-Regulation*

*Active Regulation.* Teachers rated children's active self-regulation using two separate measures: hyperactivity and conscientiousness. When reversed, hyperactivity represents an active form of self-regulation that measures the extent to which an individual can properly inhibit inappropriate urges. These urges are inhibited on-line and can be contrasted to a passive form of dysregulation in which children have not fully internalized rules and therefore misbehave.[10] For the purposes of the current study, hyperactivity was measured using two items specifically developed to examine hyperactivity related to schoolwork and classroom activities (see Hawley, 2003b).

[10] Barkley (1997) supports the argument that hyperactivity represents self-regulation; he proposed that ADHD, a disorder whose very name entails hyperactivity, is a deficiency of the self-regulatory function. This supports the previously-described use of hyperactivity to measure dysregulation. It is also possible that hyperactivity also measures some degree of automatic self-regulation, but this source of variance is controlled for below.

The superconstruct of effortful control represents one form of active regulation, and has been proposed to underlie agreeableness and conscientiousness as measured by the Big Five Factor Model of Personality (Abe, 2005; Jensen-Cambell, Rosselli, Workman, Santisi, Rios, & Bojan, 2002). Accordingly, Little and Wanner's (1999) conscientiousness and agreeableness scales were taken as measures of self-regulation. A content analysis of the items revealed that the agreeableness item appeared to measure automatic regulation while the conscientiousness items measure active regulation. Teacher-rated conscientiousness was therefore selected as an indicator of active self-regulation.

*Automatic Regulation.* Regulated conscience is a measure of automatic regulation derived from Kochanska et al.'s measure of early childhood conscience (Kochanska, DeVet, Goldman, Murray, & Putnam,1994) by Hawley and Geldhof (in preparation, see Appendix B), and primarily contains items from Kochanska et al.'s original internalization and guilt-prone subscales. This scale, in conjunction with Little and Wanner's (1999) scale of agreeableness were rated by teachers as measures representing the automatic regulation construct. All items were coded so that higher scores reflect greater regulation.

*Differentiating the Two Regulations.* To ensure that these two forms of self regulation are indeed separate but correlated, a confirmatory factor analysis was performed. Results of this analysis indicate that the two forms of regulation are highly correlated, but are by no means representative of a unidimensional construct ($r_{(315)}$ = .65, $CI_{(95\%)}$: .53, .78). Appendix C provides details of this analysis.

*Fearfulness*

A measure of general fearfulness was created by combining one item ("is fearful") from Little & Wanner's neuroticism scale (1999) and three items from their general surgency factor (i.e., "S/he immediately approaches to explore when s/he sees something new or unusual"). Surgency is a non-social aspect of extraversion, and generally describes a child's willingness to explore novel stimuli. The use of reversed surgency as a measure of fearfulness is theoretically justified in that fearful children will be inhibited from exploring novel stimuli and situations while their less fearful compatriots will be more willing to explore the same things. Items measuring surgency were reverse-coded so that higher scores on the resulting construct represented greater fearfulness.

## *Data Collection*

Teachers were given questionnaires and asked to fill out/return them. Written parental consent was obtained for each child participating in the data collection, and the children informally consented to the study by their willingness to participate.

## *Missing Data*

Missing data were imputed using the EM algorithm of PROC MI in SAS (version 9.1.3). Although the majority of missing data points (19% total missingness) appeared to be missing completely at random (MCAR), one major source of missingness stemmed from the fact that regulated conscience was not measured in the Connecticut-based sample of children ($n$ = 163). According to best practice methods,

EM data recovery was implemented using all variables available in the larger data set from which this study was drawn.

The relatively large amount of missingness required that a large number of data imputations be analyzed, and I chose to analyze twenty imputations for this study (see Enders, in press; Graham, Olchowski, & Gilreath, 2007). Gamma for all parameter estimates was .318 on average, and ranged from .013 to .806, indicating that 20 imputations should adequately capture the true sample associations with less than a five-percent decrease in power (Graham, et al., 2007).

## Analyses

The following models consist of seven constructs (fearfulness, instrumental aggression, reactive aggression, active self-regulation, automatic self-regulation, and resource control, with gender entered as a y-side covariate), which were identified and had their scales set through standardizing the latent construct variances to 1.0. This technique has an added advantage in that all latent covariances are interpretable in a standardized/correlational metric.

When using standardization to identify latent variables, it often becomes necessary to fix/constrain additional model parameters to ensure full identification of each construct. For the models presented in this paper, two latent variables need further identification constraints: fearfulness and gender. Gender was represented by a single-indicator construct, meaning that the indicator's unique variance was fixed to zero. All item-level variance was therefore represented by its factor loading, with the latent variance being standardized.

Fearfulness was represented by two parcels and was fully identified by equating their factor loadings. The construct therefore had a standardized latent variance with parcel covariance represented by the squared value of the factor loading. All item-level variance not accounted for by this covariance was then represented by each indicator's freely estimated unique variance.

The additional constraints on fearfulness were made necessary as a side effect of the item parceling technique. Parceling individual items benefits latent models in that the mean of several items more reliably represents the construct at hand by minimizing variance due to sampling error and item uniqueness. Minimizing these non-construct sources of variance further decreases the chance of having correlated indicator residuals. Parceled indicators are also more likely to adhere to the assumption of normality made by most statistical techniques such as SEM (Little, Cunningham, Shahar, & Widaman, 2002). Other constructs also made use of the parceling technique, and these parcels are next described.

Instrumental and reactive aggression were represented by six items each, making the creation of three domain-representative parcels facile. Not only is this acceptable per the nature of the hypothesized construct, but the creation of three-parcel factors is optimal in that such factors are just-identified (Brown, 2006).

Facet-representative parcels were created for the remaining constructs, meaning that each parcel represented some specific facet of the larger construct. Fearfulness was represented by two indicators, one being the neuroticism item and the second being the average of the reverse-coded surgency items. Resource control

was represented by one indicator that was the child's standardized dominance rank and two parcels that represented the resource-control scale items. Active regulation was similarly represented by three indicators, one representing by the mean of the reverse-coded hyperactivity items, and the others representing items from the conscientiousness measure.

Although the automatic regulation construct was also represented by two scales, regulated conscience and agreeableness, I chose to represent this construct using the agreeableness scale as one indicator and the indicators from the regulated conscience scale as five separate indicators. For regulated conscience, parcels were created using Kochanska's original guilt-prone and internalization items, with the remaining indicators being single items that loaded significantly onto this construct but came neither from the original guilt prone or internalization subscales. This method of parceling was chosen because it best represents the items of the experimental regulated conscience scale, further establishing this scale's validity. A lack of significantly large modification indices in the following models will show that the individual subscales are best represented by a single regulated conscience construct.

### *Bootstrapping*

This study's hypotheses predict a positive relationship between aggression and active self-regulation will be found that will be fully meditated by resource control. Because indirect effects are normally distributed only in very large samples, the common Wald statistic for significance is inappropriate. Instead, 3,000 bootstrap

samples were taken from each data imputation, and the mediation hypothesis tested on these. A distribution was created form these results and a bias-corrected and accelerated 95% confidence interval was created for the effect.

### *Assessing Fit*

No single measure of model fit is without its limitations, and I use five measures of fit to assess my structural models. The chi-squared statistic will be used to assess the probability of perfect model fit, and will be interpreted using a significance level of .05. Perfect model fit should rarely be expected, and I supplement this statistic with four alternative measures of fit.

The first two indices represent absolute model fit, or the amount of misfit between the observed and the model implied covariance matrices. The RMSEA measures the degree of model misfit per degree of freedom and is normally interpreted as being minimally acceptable at or below .10, although values of at least .08 are preferred. One downside to the RMSEA is that it does not adequately assess model fit in small models. A second index, the SRMR, can be interpreted using the same criteria as the RMSEA, but represents the mean of the squared residuals after they have been standardized.

The CFI and TLI represent a model's relative fit, or the degree of improvement that a model shows over its respective null model. Values as low as .85 are considered minimally acceptable, with values over .90 preferred.

The computation of each index is unique, and all five are not expected to agree in every model. Model fit will therefore be assessed as a gestalt, with each

index partially informing the final decision to accept or reject a given model. My final decision will also consider the use of facet-representative parcels in the automatic regulation construct. Facet representative parcels are more likely to contain residual correlations that could result in lower fit indices than would be seen with domain representative parcels.

### *Structural Models*

Based on the initial CFA, two structural models were developed. The first model allowed for all but the test of mediation, which was then tested in model two. These models are presented along with the hypothesized directions of the construct interrelationships in Figures 2 and 3.

## Results

### *Data Preparation*

#### *Self-Regulation as Two Constructs*

As described above, I expected that automatic self-regulation is a differentiated form of active regulation; although a sizeable amount of variance observed in either one will be related to the other. To examine the unique effects of each construct and eliminate collinearity problems, it is possible to control each construct for the effects of the other in all analyses.

Initial steps to orthogonalize the two constructs resulted in severe collinearity problems,[11] and it was determined that the optimal approach was to create two data

[11] If active regulation is orthogonalized with respect to automatic regulation and automatic self-regulation is orthogonalized in respect to active regulation, the two 'independent' pieces will be correlated to the same magnitude as the original constructs, but with a reversed sign (see Appendix D).

sets in which only one of the self-regulation constructs was orthogonalized with respect to the other. Because two data sets are required, all models discussed in this paper will be run twice, with results presented for each.

*Differentiation of Aggression*

Before a structural model could be implemented, I first examined if the two forms of aggression are fully differentiated within this sample. Confirmatory analysis indicated that the six aggression parcels were unidimensional (see Appendix E for details), and therefore the two aggression constructs will be treated as one for the remainder of this paper. Figures 2 and 3 reflect this unidimensionality.

*Initial CFA*

The initial CFA was tested on two data sets, one in which the shared variance between active and automatic self-regulation was removed from the active construct (active-unique), and one in which the shared variance was removed from the automatic construct (automatic-unique). All latent constructs were controlled for gender, and automatic self-regulation was additionally controlled for fearfulness. Fit statistics of the above-described CFA indicated good model fit in both the active-unique (Averages: $\chi^2_{(123)} = 542.571$, $p > .05$, RMSEA = .102 (.093, .111), SRMR = .066, CFI = .932, TLI = .915) and the automatic-unique (Averages: $\chi^2_{(123)} = 563.447$, $p > .05$, RMSEA = .103 (.094, .112), SRMR = .070, CFI = .925, TLI = .907) data, with all indicators significantly loading onto their respective indicators (see Table 1). Table 2 provides factor intercorrelations for these models.

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Additionally, structurally controlling for the shared variance resulted in collinearity between the model's parameter estimates, resulting in an unreliable model.

## *Testing the Hypotheses*

The two structural models presented in Figures 2 and 3 were fitted to test the previously-generated hypotheses. Results are presented in Figures 4 and 5. These figures provide point estimates from the active-unique models, except where automatic self-regulation was part of the estimated relationship. The latent relationships that did not involve active or automatic self-regulation changed very little across the two data sets, and the estimates from the active-unique model provide very good approximations to the estimates in the automatic-unique data.

The results presented in Figures 4 and 5 are non-standardized beta weights due to limitations with LISREL. LISREL only outputs non-standardized parameter estimates for combination using Rubin's rules or for creating confidence intervals. Unless otherwise stated, ninety-five percent confidence intervals based on Rubin's rules are presented in the following sections to help the reader determine overall significance for each parameter estimate.

### *Self-Regulation and Aggression*

Hypothesis one, that the shared variance between the aggression and active regulation constructs will be solely due to their shared variance with resource control (mediation), was tested using model two. Active regulation predicted resource control, which then predicted aggression. The direct effect of active regulation on aggression was also examined.

Active regulation positively predicted aggression ($\beta = .609$, $CI_{(95\%)}$: .313, .905) prior to controlling for resource control, and evidence for mediation was found.

Controlling for resource control revealed evidence of inconsistent mediation (see Davis, 1985, Dearing & Hamilton, 2006), in that a significant negative relationship between aggression and active self-regulation emerged after resource control was entered for ($\beta$ = -.308, $CI_{(95\%)}$: -.653, -.180). Bootstrapping revealed that the mediation path was significant ($\beta$ = .682, $CI_{(95\%)}$: .516, 1.006).

Automatic self-regulation predicted aggression within the same model, with results supporting hypothesis two. Automatic self-regulation negatively correlated with aggression when controlling for fearfulness ($r$ = -.510, $CI_{(95\%)}$: -634, -.386).

*Predicting Resource Control*

Hypothesis three and four stated that aggression and active self-regulation would both positively predict resource control. Both hypotheses were simultaneously tested, with results supporting both hypotheses. Table 3 presents the directional paths from the these models, and reveals that active regulation positively predicted resource control in the active-unique data set, and that aggression positively predicted resource control in both sets. Although no prediction was made about the relationship between automatic self-regulation and resource control, this relationship was also significant and positive.

*The Effect of Fearfulness*

The primary structural model tested both hypotheses regarding the effects of fearfulness; namely, that fearfulness would positively predict automatic self-regulation while negatively correlate with all other constructs. In this model, all constructs were allowed to freely covary while being controlled for gender. Tables 3

and 4 present the relationship between fearfulness and these other variables, and show that fear was negatively related to aggression and resource control in both data sets, and to active self-regulation in the active-unique data. As predicted, fearfulness positively predicted automatic regulation in the automatic-unique data set.

## Discussion

### *Summary*

Theory and metatheory can arise out of subjective experience or direct exposure to data. The *a priori* assumptions that stem from theory/metatheory then lead researchers to develop specific hypotheses and programs of research. By fully understanding their own theoretical and metatheoretical roots, researchers provide a solid base for their work and are able to better adapt to null results and unexpected findings.

Hobbesian metatheory accompanies a dynamic systems theoretical approach in this paper, meaning that constructs grow, differentiate, interact, and compete in ways that optimize resources. This confluence of theory and metatheory resulted in the generation of several distinct hypotheses, each with its own implications for future research and applied settings. Positive consequences (here resource control) resulted from children's consciously-regulated aggression, which informs our views of instrumental and reactive aggression. Although some instrumentally aggressive children may be socially adapted and not require intervention, they might model successful aggression to less well-regulated peers. Current research already acknowledges the different social outcomes for instrumentally and reactively

aggressive children, and this work should be expanded to incorporate the larger social influences of instrumental and reactive aggression. Suppressing aggression might also affect instrumentally and reactively aggressive children differently. Eliminating aggressive behaviors might deprive some children of their only resource acquisition mechanisms, while other aggressors might be better able to adapt.

Combining dynamic systems theory with a Hobbesian metatheory also results in a novel approach to self-regulation. The current literature considers actively regulated behaviors (Baumeister, 1998, but see Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Fitzsimmons & Bargh, 2006), and this paper acknowledges the need to understand the concurrent effects willful and automized behaviors. Both types of self-regualtion positively predict resource control, but each is distinct in its development and its associations with other constructs. Social norms do not generally promote the use of aggression, and, as expected, I found a negative correlation between automatic self-regulation and aggression. On the other hand, active self-regulation correlated positively with aggression.[12]

Active and automatic self-regulations are highly-related constructs that might appear similar to observers. Does the hyperactive child act out because s/he cannot actively control his/her behaviors or because s/he has not adequately internalized societal norms? Similarly, is the well-behaved child highly regulated, or has s/he simply internalized social rules? Answering these and other questions about self-

[12] N.B. that this relationship became negative when resource control was controlled for

regulated behavior requires a deeper understanding of the active and automatic forms and an acknowledgement of their uniqueness. Both are provided in this paper.

A set of ancillary hypotheses about the effects of fearfulness was tested in this paper. I defined fear as a generally inhibited temperament that results in an unwillingness to explore novel situations. Fearfulness positively predicted automatic self-regulation, further expanding the questions raised above. When a child behaves appropriately, is it because his/her behavior was actively regulated, because a rule was internalized and followed effortlessly, or because the child was simply fearful and therefore unwilling to engage his/her environment? Just as active self-regulation is informed by controlling for automatic regulation, active and automatic regulations are informed by the presence of fearfulness in a model. Any research or intervention that makes use of a child's ability to actively self-regulate should take note of all three forms of behavioral regulation.

In sum, understanding the interconnected development of aggressive and self-regulatory behaviors in respect to socially adaptive and maladaptive behaviors can greatly inform future research and interventions. This paper provides a novel framework for interpreting aggression, self-regulation, and resource control that is grounded in theory and acknowledges multiple forms of constructs that are normally considered unitary (e.g., self-regulation). Because this framework informs constructs and hypotheses in a general way, it can be expanded to incorporate additional constructs and lead to future growth in the field.

## Limitations of the Present Study

In this study, only instrumental prosocial control was measured. The distinction between instrumental and non-instrumental prosociality is not yet understood, and subsequent work should include measures of both to better understand the individual effects of each. There were also at least two methodological limitations: regulated conscience is not a fully validated measure and the absence of longitudinal data points.

### *Future Directions*

Although the collection of new variables and the potential creation of a new methodological procedure will greatly help our understanding of the variables at hand, I feel that longitudinal data collection is the most important direction to take. The hypotheses made in this study are almost entirely rooted in dynamic theory, and longitudinal data are required to truly test them. More data are currently being collected on this sample, which means the addition of new participants and longitudinal data. These new data will allow for a longitudinal follow up of the hypotheses and validation of the regulated conscience scale in a new sample of children.

If differentiation as I have defined it does occur, and if the expected relationships hold across time, then future models can examine causal relationships in detail. For instance, the differentiation of aggression may very well be due to a preceding increase in active regulation. The establishment of these causal models will

require a much more intricate assessment that may require a series of measurement-intensive short term longitudinal studies.

Future work should also focus on more accurate measures of active and automatic regulation. New observational measures have been added to the follow-up data collection, and are specifically geared towards measuring active self-regulation. The hyperactivity and conscientiousness measures may contain reporter bias, and we are now measuring active self-regulation with observational measures.

I am not currently aware of any direct measures of automatic regulation, and the creation of one should be considered. Automatic regulation is expected to arise directly from active regulation, and is expected to grow across the lifespan. If measures of automatic regulation cannot be devised, it may prove beneficial to find a statistical process that allows for orthogonalization while maintaining information about the indicator means.

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Table 1.

*Indicator Loadings of the Initial CFA (95% CI)*

| | Active Unique | | | | Automatic Unique | | | |
|---|---|---|---|---|---|---|---|---|
| Indicator | Loading | CI-Lo | CI-Hi | γ | Loading | CI-Lo | CI-Hi | γ |
| Gender | .500 | .460 | .539 | n/a | .500 | .460 | .539 | n/a |
| FNeuro | .577 | .503 | .652 | .020 | .577 | .502 | .653 | .018 |
| FSurg | .577 | .503 | .652 | .020 | .577 | .502 | .653 | .018 |
| Agg1 | .767 | .697 | .838 | .036 | .766 | .697 | .835 | .038 |
| Agg2 | .723 | .648 | .798 | .071 | .723 | .649 | .797 | .075 |
| Agg3 | .785 | .717 | .852 | .053 | .785 | .720 | .851 | .053 |
| Consc_1 | .520 | .435 | .606 | .329 | .679 | .597 | .762 | .155 |
| Consc_2 | .579 | .471 | .686 | .445 | .679 | .578 | .779 | .312 |
| Rev_Hyp | .466 | .376 | .555 | .249 | .675 | .588 | .762 | .056 |
| Agree | .593 | .502 | .684 | .266 | .454 | .366 | .542 | .317 |
| Guilt | .384 | .232 | .535 | .599 | .248 | .082 | .415 | .680 |
| Internal | .758 | .646 | .870 | .441 | .582 | .469 | .695 | .557 |
| Concern | .582 | .405 | .759 | .561 | .509 | .320 | .698 | .614 |
| Apology | .366 | .162 | .570 | .556 | .271 | .047 | .496 | .631 |
| Confess | .769 | .553 | .985 | .757 | .629 | .399 | .860 | .806 |
| Rescon_1 | .673 | .579 | .766 | .382 | .670 | .576 | .763 | .365 |
| Rescon_2 | .698 | .607 | .789 | .292 | .700 | .608 | .791 | .289 |
| Dom Rank | .804 | .704 | .903 | .112 | .806 | .706 | .906 | .103 |

Table 2.

*Latent Correlations: CFA Point Estimates*

| | Fear ResCon | Gender | Agg | ActR | ActR* | AutR | AutR* | |
|---|---|---|---|---|---|---|---|---|
| Fear | 1.00 | | | | | | | |
| Gender | .026 | 1.00 | | | | | | |
| Agg | -.671 | -.070 | 1.00 | | | | | |
| ActR | .027 | -.217 | -.320 | 1.00 | | | | |
| ActR* | -.323 | -.171 | .184 | ----- | 1.00 | | | |
| AutR | .497 | -.112 | -.821 | ----- | 0.00 | 1.00 | | |
| AutR* | .556 | .024 | -.793 | 0.00 | ----- | ----- | 1.00 | |
| ResCon | -.793 | -.080 | .719 | .195 | .531 | -.412 | -.639 | 1.00 |

All correlations from active-unique unless AutR* is specifically stated

* When that construct is unique

Table 3.

*Estimated Betas*

| Active-Unique | | | | | |
|---|---|---|---|---|---|
| | Fear | Agg | ActR | AutR | ResCon |
| Gender Predict: | .025 | -.070 | -.175 | -.143 | .307 |
| 95% CI | -.110, .160 | -.184, .044 | -.313, -.036 | -.287, .001 | .055, .558 |
| Fear Predict: | - - | - - | - - | .552 | - - |
| 95% CI | - - | - - | - - | .348, .755 | - - |
| Predict Res. Con.: | - - | 2.493 | .609 | .920 | - - |
| 95% CI | - - | 1.490, 3.496 | .313, .905 | .166, 1.675 | - - |

| Automatic-Unique | | | | | |
|---|---|---|---|---|---|
| | Fear | Agg | ActR | AutR | ResCon |
| Gender Predict: | .025 | -.071 | -.222 | .012 | .286 |
| 95% CI | -.111, .162 | -.184, .043 | -.348, -.096 | -.142, .166 | .017, .555 |
| Fear Predict: | - - | - - | - - | .671 | - - |
| 95% CI | - - | - - | - - | .420, .921 | - - |
| Predict Res. Con.: | - - | 2.641 | 1.237 | .920 | - - |
| 95% CI | - - | 1.438, 3.843 | .658, 1.816 | .166, 1.675 | - - |

Table 4.

*Correlations with fearfulness, gender controlled*

| | Agg | ActR | ResCon |
|---|---|---|---|
| Active Unique: | -.654 | -.291 | -.366 |
| 95% CI | -.753, -.555 | -.445, -.136 | -.537, -.196 |
| Automatic Unique: | -.669 | .029 | -.349 |
| 95% CI | -.767, -.571 | -.119, .178 | -.526, -.172 |

Figure 1.

*Interaction of the level one and level two selves*

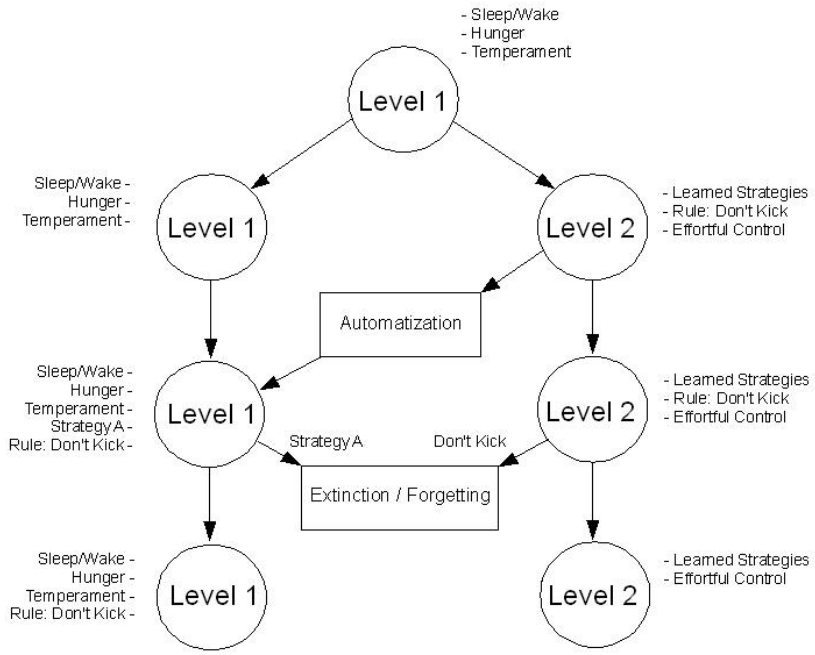


*Figure 2.*

*Hypothesized Model: Model One*

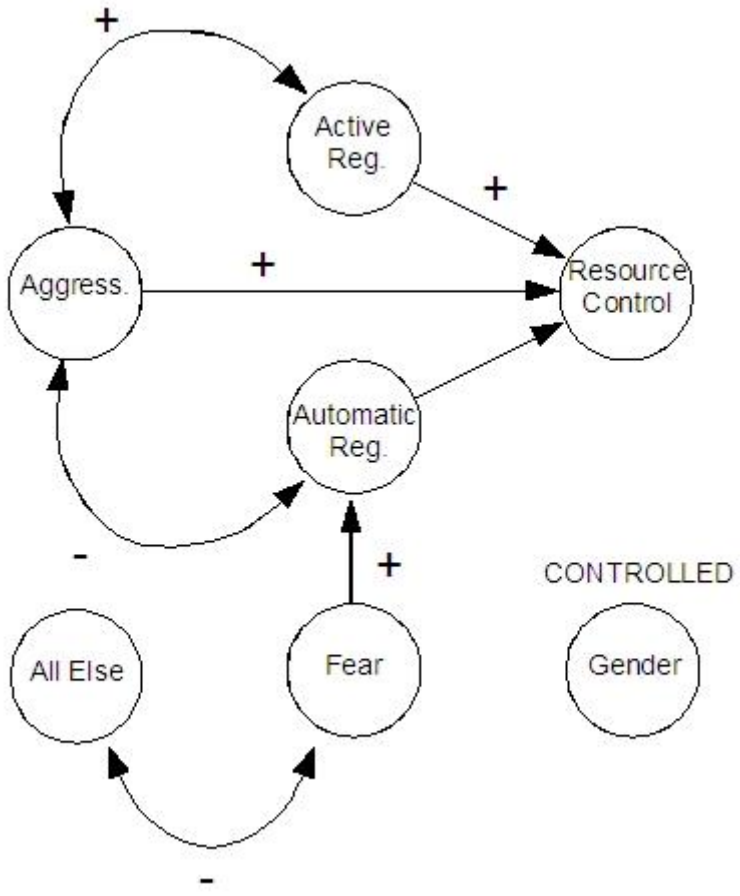


*Figure 3.*

*Hypothesized Model: Model Two*

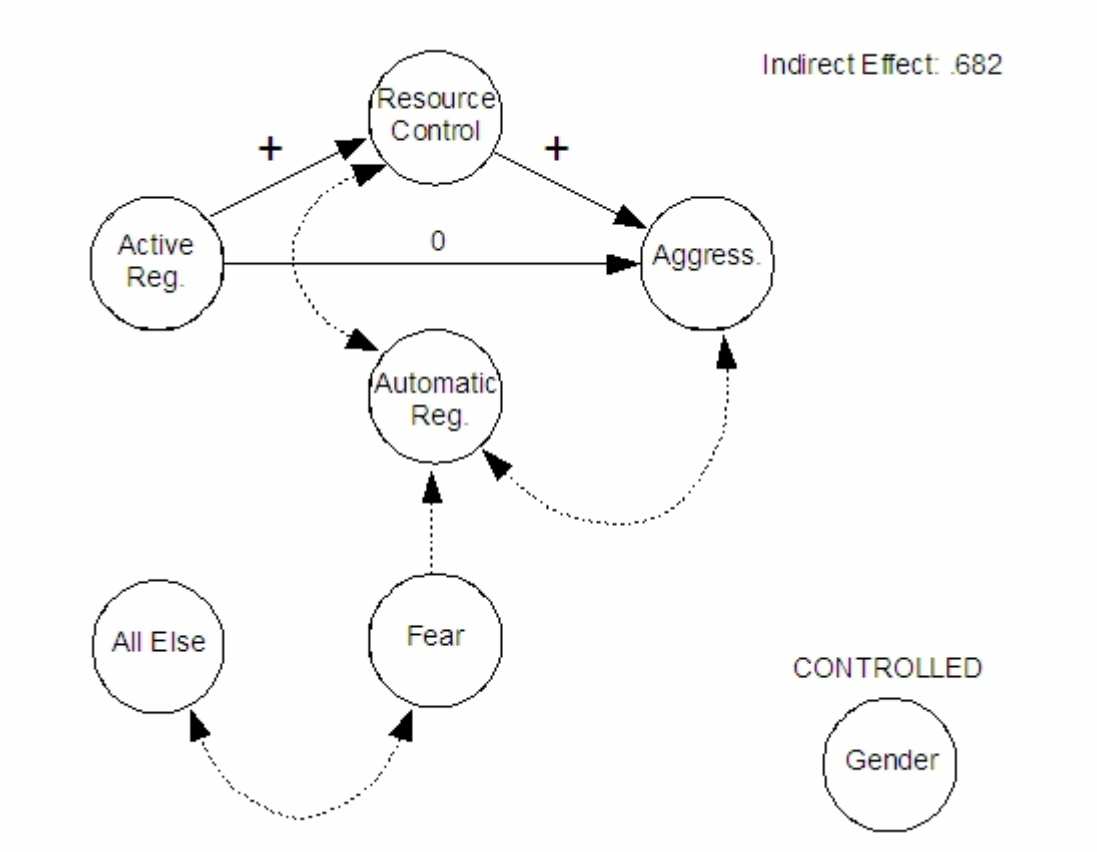


*Figure 4.*

*Results: Model One*

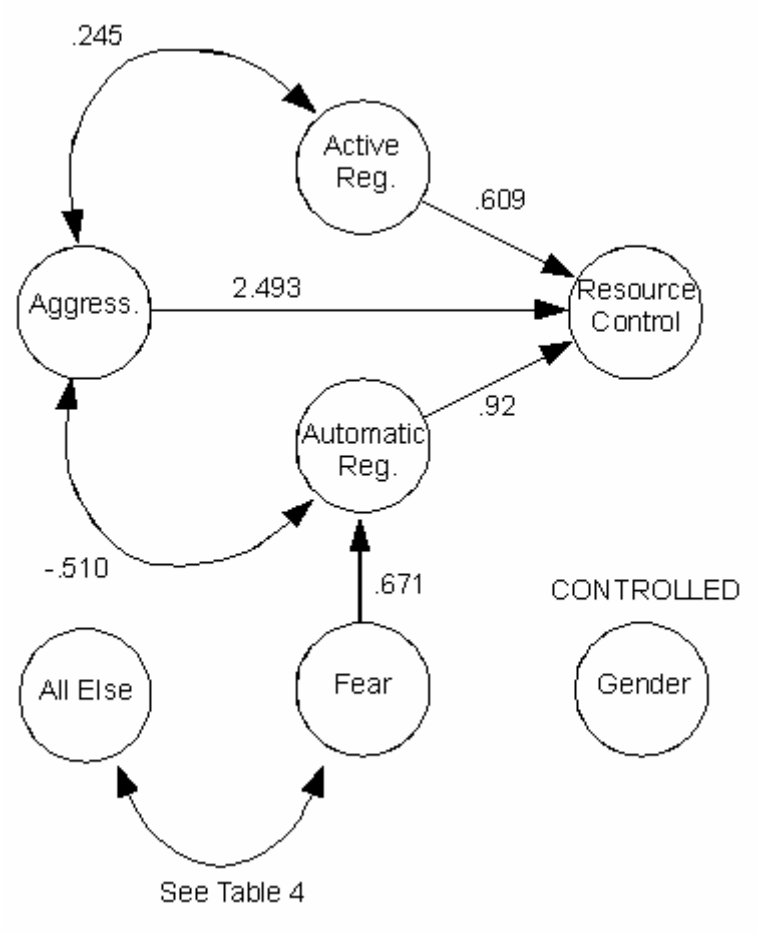
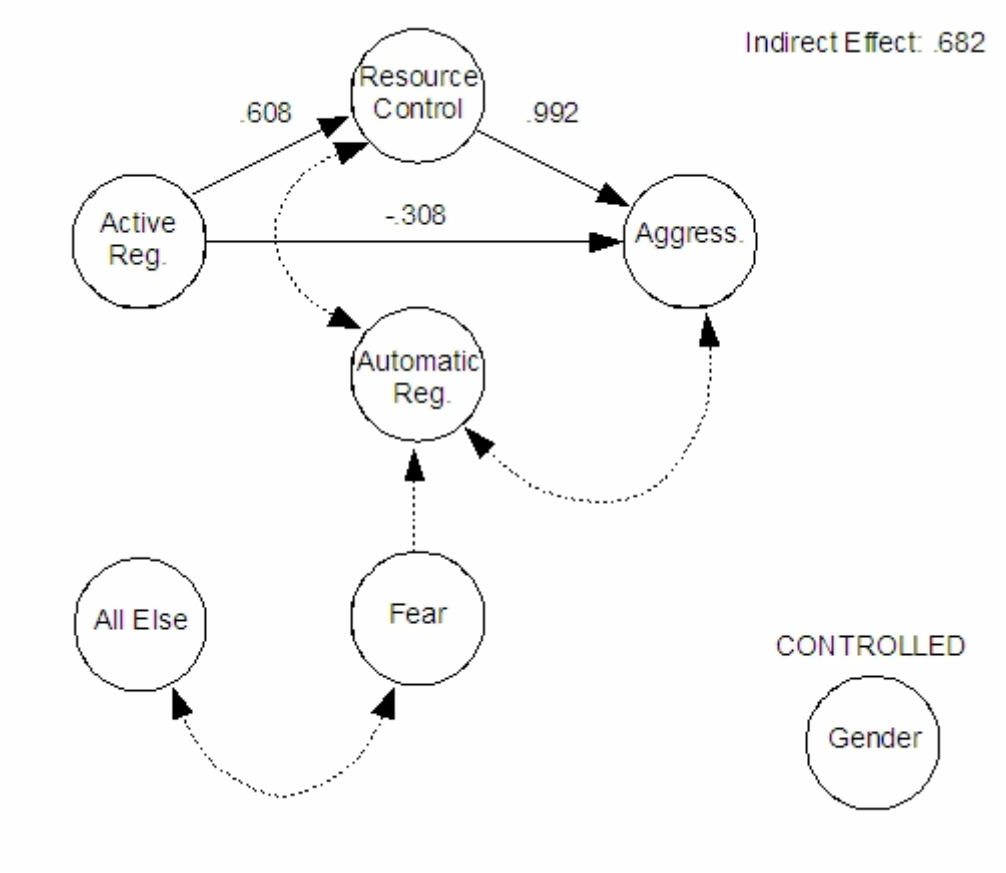


*Figure 5.*

*Results: Model Two*



# Appendix A

## The Development of Self-Regulation

The ability to purposefully attend to stimuli (a form of active behavioral regulation) can be observed even in neonates, as many features of attention (e.g., smooth pursuit of a visual stimulus, externally driven saccades) are present from birth. This does not mean that it is fully optimal to study self-regulation at such an early age. Fully endogenous attention (such as sustaining or inhibiting attention) does not completely develop until the later half of the first year or later (Colombo, 2001; Ruff & Rothbart, 1996 REG Child Adj.).

Additionally, these two forms of attention appear to be physically different. Early attention is likely a series of automatic responses to stimuli that arise within the posterior orienting system in the superior colliculus, pulvinar nucleus, and the parietal lobe (Derryberry & Rothbart, 1997, Rothbart & Bates, 1998). More endogenous forms of attention arise in the anterior cingulate cortex (Derryberry & Rothbart, 1997, Posner & Rothbart, 1998, Rothbart & Bates, 1998).

The frontal lobes also play a significant role in the development of self-regulation, and although the frontal lobes develop well into adolescence (Nelson & Luciana, 2001; REG Dev of Reg), voluntary regulation and inhibition can be seen in children even before the third year (see Calkins & Johnson, 1998). When, then, should self-regulation be studied?

Kochanska found that effortful control increases between 22 and 33 months (Kochanska et al., 2000), with other studies suggesting an increase self-regulation that can last until the sixth year. By the time a child is 45 months old, self-regulation has stabilized in certain contexts (Kochanska, et al., 2001), and behavioral and emotional regulations effected children differently at either three or five years of age (Kalpidou, Power, Cherry, & Gottfried, 2004).

Other studies have shown superior regulatory functioning in five-year olds as compared to younger children; stroop-type task scores are better in five year olds (Diamond & Taylor, 1996; Gerstadt, Hong, & Diamond, 1994), three year olds perform more poorly in the tapping task than older preschoolers (Diamond & Taylor, 1996), and five-year-old preschoolers perform better than their four-year-old peers on go/no go tasks (Livesey & Morgan, 1991). Backen Jones, Rothbart, and Posner (2003) also found a large development in inhibition (a form of self-regulation) between the fourth and fifth years, mirroring findings that show 'Simon Says' type inhibition does not develop until 40 months and is weak until at least 44 months of age (Posner & Rothbart, 1998; Reed, Pien, & Rothbart, 1984). It is therefore appropriate and interesting to study the effects of self-regulation during the height of (and briefly after) this regulatory growth spurt, specifically between the ages of three and five.

# Appendix B

## An Exploratory Factor Analysis of Kochanska and Colleagues' Conscience Questionnaire

Hawley and Geldhof (in preparation) factor analyzed a subset of items from Kochanska et al.'s (1994) conscience questionnaire. Included items came from the original guilt prone, concern for good feelings with teachers, confession, apology, reparation, concern for other's transgressions, internalization, and empathy subscales, and can be found in Table B1.

To determine the optimal number of factors, a scree plot was first generated (see figure A1), and the number of factors with the lowest eigenvaule greater than one was used. This analysis was performed using OLS extraction and Harris-Kaiser rotation. Table A2 shows the standardized factor loadings for all items within this analysis; one item (Emp3) was dropped due to poor loadings.

The three resulting factors appeared to represent the latent variables of: moral atmosphere maintenance, regulated conscience, and internalized prosociality. The first factor, moral atmosphere maintenance, consisted of items from the concern for others' transgressions and concern for good feelings with teacher subscales of Kochanska's original questionnaire. This construct correlated negatively with regulated conscience ($r$ = -.31), and internalized prosociality ($r$ = -.20), indicating that it represented something not at all like the internalization that the items were intended to measure. Closer examination of the items themselves revealed that the common thread within them was a nearly amoral regard of others and an especial emphasis on

maintaining the moral atmosphere for one's self-benefit. This type of behavior echoes the proposed thinking of Hawley's bistategic controllers.

The next factor, regulated conscience, consisted primarily of items from Kochanska et al.'s original internalization and guilt prone subscales and represents a factor of internalized rules (a form of automatic regulation). The internalization items as well as one of the confession items were included in this subscale despite large (negative) loadings onto the factor of moral atmosphere maintenance because they simultaneously had a positive loading onto the regulated conscience factor, which itself was negatively correlated to moral atmosphere maintenance.

The items loading onto this factor belie the difference between regulated conscience and measures of active regulation; many items loading onto regulated conscience reflect either emotional upset that derives from moral transgressions (i.e., showing guilt or remorse after performing a transgression) or behaving in 'appropriate' ways when caught. These items measure the degree to which rules have been internalized by observing a child's reaction when they are broken.

An alternative interpretation of this construct is that observed guilt is nothing more than an emotional response to poor active regulation or to a breach in the child's social responsibility. Were this true, guilt would still only arise if an already automatized regulation scheme (rule or norm) had been broken. No guilt can be expected to result from a child's misbehavior when the child does not perceive the misbehavior as wrong.

The final factor, internalized prosociality included items from Kochanska's apology, empathy, confession, and reparation subscales. This construct was highly correlated with regulated conscience ($r$ = .61), and like regulated conscience represents a form of automatic regulation. The two constructs differ, however, in that they represent a child's overall internalization of different behaviors. Regulated conscience represents a form of automatic regulation that stems from repeatedly regulating towards and therefore following rules while internalized prosociality represents the internalization of prosocial behaviors as mandated by adults and the peer group.

Table B1.

*Items from Kochanska's internalization scale*

Guilt1: Likely to look remorseful or guilty when caught in the middle of a forbidden activity
Guilt2: May hang his/her head and look down after being naughty
Guilt3: Not too upset by mishaps or accidents s/he has had (*reversed*)

ConGF1: May become extra nice toward the teacher after being caught doing something wrong
ConGF2: Is not overly concerned about being forgiven after having done something naughty (*reversed*)
ConGF3: After doing something s/he is not supposed to do, they later check with teacher to see if s/he is "good now"

Confess1: May deny s/he did something wrong even when confronted with the evidence (*reversed*)
Confess2: May confess to doing something naughty even if unlikely to be found out
Confess3: Seems compelled to tell teacher when s/he does something wrong

Apol1: Will spontaneously say "sorry" after having done something wrong
Apol2: Unless specifically asked to, s/he is not likely to apologize on his/her own (*reversed*)
Apol3: Will spontaneously say "sorry" to a peer when necessary

Repar1: Seems relieved when given an opportunity to repair damage s/he has caused
Repar2: Is not particularly likely to offer to clean up is s/he has caused a mess (for example, a spill) (*reversed*)
Repar3: When s/he has hurt a playmate, will try to make up for it by offering toys or prized possession to the other child.

ConOth1: Is likely to scold another child who violates a classroom rule
ConOth2: Gets upset when a peer breaks a classroom rule
ConOth3: Not likely to react when a peer breaks a classroom rule (*reversed*)

Intern1: Rarely repeats previously prohibited behavior even if an adult is not present
Intern2: Can stop her/himself in the middle of doing something forbidden without any intervention from an adult
Intern3: if out of teacher sight s/he may ignore a classroom rule (*reversed*)

Emp1: Will try to comfort or reassure another in distress
Emp2: Likely to offer toys or candy to a crying playmate even without teacher suggestion
Emp3: Is not likely to become upset if a playmate cries (*reversed*)

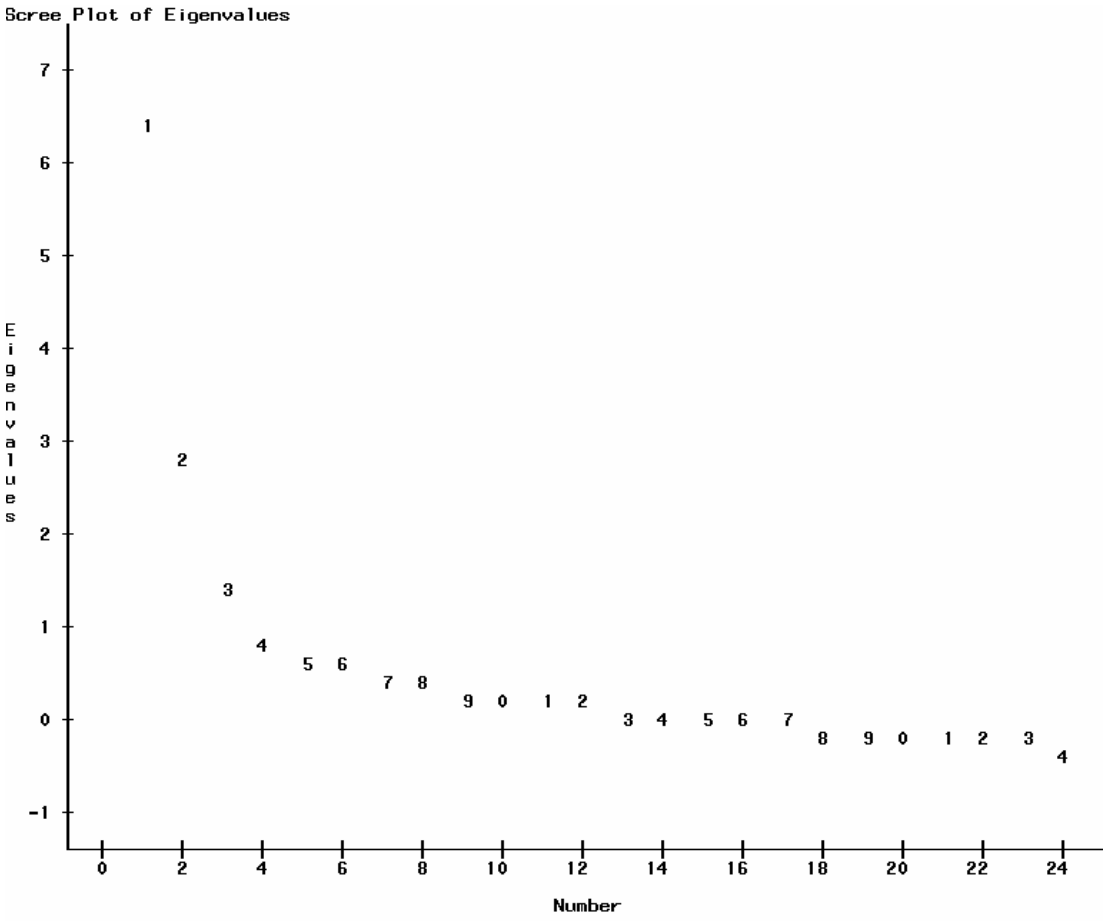
Table B2.

*Three factor solution*

| Variable | Factor1 | Factor2 | Factor3 |
|---|---|---|---|
| ConGF1 | 0.**41862** | 0.11354 | 0.13214 |
| ConGF3 | 0.**37858** | 0.17919 | -0.09608 |
| ConOth1 | 0.**70196** | 0.14677 | 0.31081 |
| ConOth2 | 0.**57440** | 0.**40497** | 0.23635 |
| ConOth3 | 0.**69541** | 0.30521 | 0.02846 |
| Guilt1 | 0.11009 | 0.**64358** | 0.10777 |
| Guilt2 | 0.09341 | 0.**60055** | -0.06558 |
| Guilt3 | 0.11846 | 0.**86518** | -0.36005 |
| ConGF2 | - 0.15267 | 0.**46710** | 0.20899 |
| Apol2 | 0.17717 | 0.**45794** | 0.19311 |
| Intern1 | - 0.**63811** | 0.14177 | 0.**30055** |
| Intern2 | - 0.30017 | 0.**48983** | 0.17248 |
| Intern3 | - 0.54251 | 0.**42455** | 0.07886 |
| Confess1 | - 0.**54777** | 0.**45125** | 0.04870 |
| Apol1 | 0.05039 | -0.10415 | 0.**88709** |
| Apol3 | - 0.00579 | -0.01747 | 0.**81293** |
| Emp1 | 0.10422 | -0.04658 | 0.**67895** |
| Emp2 | 0.21246 | -0.31188 | 0.**66092** |
| Confess2 | - 0.15163 | 0.04914 | 0.**38402** |
| Confess3 | - 0.29840 | 0.16190 | 0.**50189** |
| Repar1 | - 0.19689 | 0.05192 | 0.**59362** |
| Repar2 | - 0.14311 | 0.21519 | 0.**34882** |
| Repar3 | 0.13739 | -0.15306 | 0.**61556** |
| Emp3 | - 0.13031 | -0.05027 | 0.04615 |

Figure B1.

*Scree plot of eigenvalues*



# Appendix C

## The Bidimensionality of Active and Automatic Self-Regulation

Confirmatory factor analysis (CFA) was used to verify the bi-dimensionality of the active and automatic regulation constructs. Unidimensionality was not expected, and it was decided that examining the constructs in isolation from other constructs was adequate. A two construct model was therefore created in which both active regulation and automatic regulation were identified using the latent standardization method. Active Regulation was represented by three indicators, two being parcels of Little & Wanner's (1999) conscientiousness items and one being a parcel of Hawley's (2003b) reverse-coded hyperactivity items. Automatic regulation was represented by six indicators, one being a parcel of Little & Wanner's (1999) agreeableness items, with the remaining five representing facets (guilt, internalization, concern for others, apology, and confession) of the regulated conscience factor found by Hawley & Geldhof (in preparation). Facet-representative parcels were created because regulated consciousness is still largely experimental and it is important to understand how the individual subscales within this construct behave.

The resulting model had acceptable model fit across imputations (Averages: $\chi^2_{(26,\, n = 315)} = 121.10$, $p > .01$; RMSEA = .104 (.084, .123); TLI = .932; CFI = .951; SRMR = 060), with all indicators significantly loading onto their respective constructs (see table B1). The latent constructs were highly correlated as hypothesized ($r_{(315)} = .65$, $CI_{(95\%)}$: .53, .78), but constraining their equality led to a

significant decrease in model fit as defined by both the nested significance and reasonableness tests (Range of $\Delta\chi^2_{(1,\, n = 315)}$: 113.002 - 241.960, all $p < .0001$). It was therefore determined that the two constructs are, distinct but highly correlated.

Table C1.

*Indicator loadings from the Lamba Matrix*

| Indicator | Loading | 95% Lower | 95% Upper |
|---|---|---|---|
| Consc_1 | .692 | .610 | .774 |
| Consc_2 | .670 | .567 | .773 |
| Rev_Hyp | .671 | .583 | .758 |
| Agree | .587 | .486 | .688 |
| Guilt | .433 | .283 | .582 |
| Internal | .744 | .619 | .868 |
| Concern | .601 | .394 | .807 |
| Apology | .427 | .225 | .628 |
| Confess | .749 | .532 | .996 |

# Appendix D

## The Effects of Orthogonalizing Two Variables Relative to Each Other

To demonstrate that the orthogonalized residuals are in fact correlated to the same magnitude (but reversed direction) as the original construct, it is easiest to examine the variables graphically in two-dimensional space. Each construct can be represented as two line segments originating at some common point where the angle between the two lines is equal to the inverse cosine of the two constructs' correlation. Two completely orthogonal constructs will therefore be represented by line segments separated by 90 degrees.

If we take two constructs, A and B, which are correlated .866, they can be represented by lines separated by 30 degrees (figure D1a). Orthogonalizing B in respect to A will cause A to remain stationary while increasing the angle between A and B to 90 degrees (figure D1b). Orthogonalizing A in respect to the original B variable results in the lines represented in figure D1c, which have a 150 angle between them (30 + 30 + 90 = 150). The cosine of this angle reveals a correlation that is exactly the opposite as the correlation between the original two indicators (-.866). Mathematically, this relationship can be shown as:

$$\cos( [2*\{90-\cos^{-1}(r)\}] + [\cos^{-1}(r)] )$$

Where the quantity $[90-\cos^{-1}(r)]$ represents the number of degrees that one construct must move to become orthogonal to the other, and $[\cos^{-1}(r)]$ describes the angle representing the original correlation.

*Figure D1*

*Linear dependency in dually orthogonalizing two variables*

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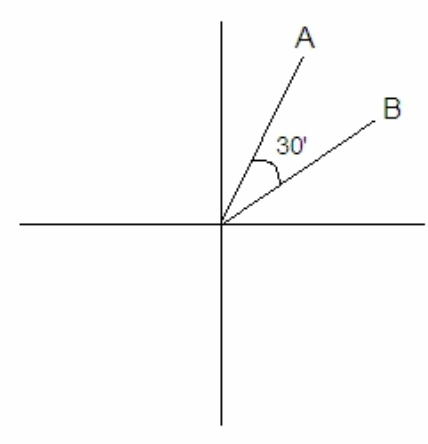
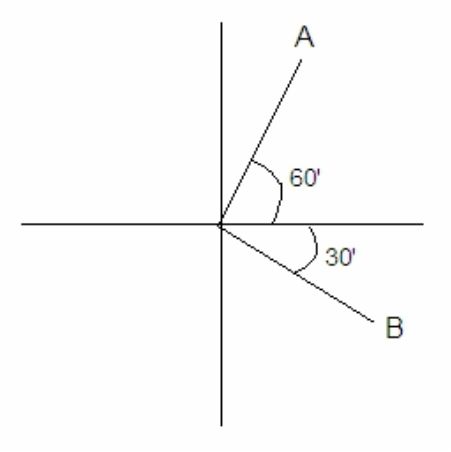
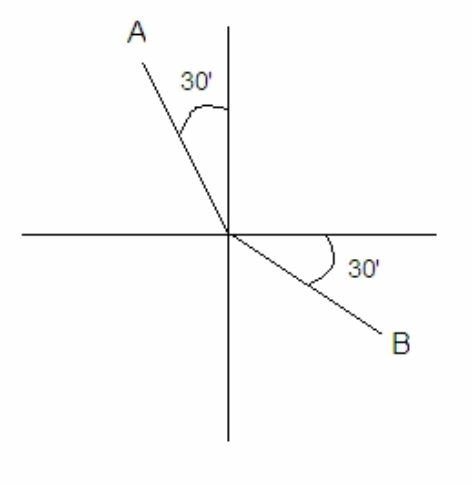
A)




B)




C)


A
30'
30'
B

# Appendix E

## Are Instrumental Aggression and Reactive Aggression Different?

Unlike the instance of the two self-regulation constructs examined in Appendix C, there was a significant chance of finding unidimensionality between the reactive and instrumental aggression latent variables[13]. Because of the increased likelihood of finding unidimensionality, it was decided that unidimensionality should be examined within the context of the study's other constructs; if two constructs truly represent the same underlying factor, then they should also correlate with outside factors to equal degrees. For instance, two constructs (A and B) might correlate very highly (say $r = .90$, sharing 81% of their variance), but be bi-dimensional if each has a strikingly different relationship with an outside factor (C).

Unidimensionality was therefore tested using the full model described above, and was examined using two data sets, one in which the variance shared by active and automatic self-regulation was removed from the active regulation indicators (active unique), and one in which the shared variance was removed from the automatic regulation indicators (automatic unique). Fit statistics for both models were moderately acceptable (active unique averages: $\chi^2_{(171,\, n = 315)} = 560.548$, $p > .001$; RMSEA = .080; TLI = .887; CFI = .908; automatic unique averages: $\chi^2_{(171,\, n = 315)} = 579.059$, $p > .001$; RMSEA = .082; TLI = .876; CFI = .899), with all indicators significantly loading onto their respective constructs (see table E1).

[13] N.B. that this was already found in previous examinations of this data set.

The latent correlation between the two aggression constructs was out of bounds (exceeded 1.0) in both models, with further support of collinearity given by the remainder of the psi matrix. The latent covariances between reactive aggression and the other model latent variables mirrored the same relationships with instrumental aggression (see Tables E2 and E3 for details). Unidimensionality was then tested empirically by fixing the latent correlation between the two aggression constructs to 1.0, and forcing the correlation of each non-aggression construct and the two aggressions to equality. The resulting model changes did not significantly reduce model fit (active unique: average $\Delta\chi^2_{(6,\, n = 315)} = 4.506$, all $p$'s > .05; automatic unique: average $\Delta\chi^2_{(6,\, n = 315)} = 5.400$, all $p$'s > .05), indicating that the two aggressions truly reflect variance of the same the same latent construct.

Table E1.

*Indicator loadings from the Lamba Matrix*

| | Active Unique | | | Automatic Unique | | |
|---|---|---|---|---|---|---|
| Indicator | Loading | 95% Low | 95% Up | Loading | 95% Low | 95% Up |
| Gender | .500 | .461 | .539 | .500 | .461 | .539 |
| FNeuro | .577 | .502 | .652 | .577 | .501 | .652 |
| FSurg | .577 | .502 | .652 | .577 | .501 | .652 |
| Inst1 | .077 | .025 | .129 | .078 | .026 | .129 |
| Inst2 | .394 | .336 | .453 | .394 | .336 | .452 |
| Inst3 | .356 | .300 | .412 | .356 | .300 | .412 |
| Rea1 | .175 | .126 | .224 | .176 | .127 | .225 |
| Rea2 | .363 | .300 | .426 | .362 | .299 | .425 |
| Rea3 | .355 | .270 | .441 | .356 | .271 | .441 |
| Consc_1 | .522 | .436 | .607 | .688 | .603 | .773 |
| Consc_2 | .579 | .469 | .688 | .688 | .586 | .791 |
| Rev_Hyp | .464 | .375 | .553 | .656 | .567 | .745 |
| Agree | .550 | .449 | .652 | .408 | .309 | .507 |
| Guilt | .421 | .263 | .579 | .293 | .121 | .465 |
| Internal | .769 | .643 | .896 | .595 | .464 | .727 |
| Concern | .599 | .397 | .801 | .527 | .309 | .744 |
| Apology | .403 | .200 | .608 | .309 | .086 | .531 |
| Confess | .768 | .546 | .989 | .628 | .386 | .870 |
| Rescon_1 | .665 | .570 | .760 | .661 | .566 | .757 |
| Rescon_2 | .712 | .621 | .803 | .714 | .622 | .805 |
| Dominance | .798 | .697 | .900 | .801 | .699 | .903 |

Table E2.

*Latent correlations with instrumental aggression (n=315)*

| | Active Unique | | | Automatic Unique | | |
|---|---|---|---|---|---|---|
| Indicator | Point | 95% Low | 95% Up | Point | 95% Low | 95% Up |
| Fear | -.251 | -.409 | -.093 | -.252 | -.410 | -.094 |
| Act_Reg | .248 | .072 | .424 | .164 | .018 | .310 |
| Auto_Reg | -.086 | -.247 | .075 | -.236 | -.409 | -.064 |
| Res. Ctrl. | .458 | .333 | .583 | .459 | .334 | .584 |

Table E3.

*Latent correlations with reactive aggression (n=315)*

| | Active Unique | | | Automatic Unique | | |
|---|---|---|---|---|---|---|
| Indicator | Point | 95% Low | 95% Up | Point | 95% Low | 95% Up |
| Fear | -.274 | -.447 | -.102 | -.275 | -.447 | -.102 |
| Act_Reg | .290 | .092 | .487 | .201 | .049 | .352 |
| Auto_Reg | -.039 | -.223 | .145 | -.195 | -.402 | .011 |
| Res. Ctrl. | .431 | .286 | .576 | .431 | .286 | .576 |