PRESCHOOLERS' ENDOGENOUSLY TRIGGERED SELF-REGULATION

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by

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The undersigned, appointed by the dean of the Graduate School,

have examined the thesis entitled

PRESCHOOLERS' ENDOGENOUSLY TRIGGERED SELF-REGULATION

Presented by Christina Squires

A candidate for the degree of

Master of Science

And hereby certify that, in their opinion, it is worthy of acceptance.

Professor Louis Manfra

Professor Jean Ispa

Professor Stacey Wagovich

DEDICATIONS

I dedicate my thesis work to my mother; thank you for being my source of strength and support.

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I offer my sincerest gratitude to my committee for their guidance throughout this process. A special thanks to my committee chair and faculty advisor Louis Manfra for his guidance, support, and patience. Thank you for giving me the courage and freedom to question thoughts, challenge pre-existing notions, and explore novel ideas.

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Academic Abstract

Common laboratory tasks that assess self-regulation in early childhood use a protocol in which regulatory demands are generated by the experimenter (i.e., exogenously triggered) and not generated by the participant. It was the goal of this study to examine preschool children's ability to regulate between competing response options that were endogenously triggered (i.e., generated by the preschoolers) in a controlled laboratory setting. To do so, a new self-regulation task, the *Pour Task,* was utilized. Data were collected from 48 children attending a university-affiliated preschool. Forty of these children met task requirements and were tested for their ability to regulate two endogenously triggered and two exogenously triggered response options. Seventy-two percent (N = 29) of children in this sample demonstrated endogenously triggered regulation. Similarly, seventy percent (N = 28) of the sample demonstrated exogenously triggered regulation. An intriguing finding emerged when comparing performance across the endogenous and exogenous test trials: nineteen children (47.5%) demonstrated one form of regulation, but not the other (i.e., either endogenously or exogenously triggered but not both). Thus, while the majority of the participants' demonstrated regulation on at least one test trial, regulatory competency of almost half of the children in this study depended on response option genesis.

Keywords: Self-regulation, Early childhood, Endogenous, Exogenous, Delay of gratification

Preschoolers' Endogenously Triggered Self-Regulation

Introduction

Self-regulation is considered an important part of adaptive cognitive, socioemotional, and behavioral functioning (Bronson, 2000). The ability to regulate thoughts, actions, and emotions in early childhood has been associated with a number of important outcomes including school readiness, academic success, social competence, constructive coping, problem solving, personal distress, emotional control, and obesity (Graziano, Calkins, & Keane, 2010; Kochanska, Murray, & Harlan, 2000; Ponitz et al., 2008; Ponitz, McClelland, Matthews, & Morrison, 2009; Rafaelli, Crockett, & Shen, 2010). Because self-regulation is vital to psychological and socioemotional wellbeing, it has been well studied and a variety of constructs (e,g., effortful control, attentional flexibility, inhibitory control, executive functions, cognitive control, etc.) related to, and often synonymous with, self-regulation appear throughout the developmental literature (Anderson, 1998; Miller & Cohen, 2001; Moilanen, Shaw, Dishion, Gardner, &Wilson, 2010; Posner & Rothbart, 2000; Stahl & Pry, 2005). Despite differences in nomenclature, these constructs significantly overlap in meaning, components, and methods of measurement (McClelland et al., 2007; McClelland & Cameron, 2012; Spinrad, Eisenberg, & Gaertner, 2007; Zhou, Chen, & Main, 2012).

To illustrate this, several exemplar definitions of self-regulation and constructs related to self-regulation are presented in Table 1. It is clear from these definitions the many similarities among the constructs. First, each definition implicates the presence of two or more demands or response options. These response options can stem from internal sources (i.e., the individual generates the demand, such as "*I want to play")* or

external/environmental sources (i.e., someone or something outside the individual generates the demand, such as a mother saying "*Go clean your room!"),* depending on the specific regulatory episode. Demands that are generated internally are *endogenously triggered*, and demands that are generated externally are *exogenously triggered*. Second, each definition implies competition between the demands such that commitment to one demand precludes commitment to a second demand. As a result of this direct competition, conflict between demands is created and the need to suppress or inhibit one response option arises. Third, each definition implies volitional control over thoughts and actions such that the simultaneous suppression of one response and the activation of another response is achieved without external influence. This, of course, is necessary for behavior to be *"self"* regulation rather than *"other"* regulation.

These three components are easily seen in everyday examples of commonly faced regulatory dilemmas. For example, both at home and in early care settings, preschool children are often asked to take a nap by their care provider. This usually requires children to stop their current activity (e.g., playing) to comply with the caretaker's request to nap. In this example, there are two competing demands with which children are contending: (a) continue to play and (b) comply with teacher directives to nap.

The presence of conflict stemming from competing demands is necessary for regulation to occur. For instance, in the example above, if children no longer want to play and are eager to nap, the two demands no longer come into direct competition with one another. As a result, conflict is not present. Without two competing desires, children do not need to regulate to suppress one response in order to activate another. In this context, the children's abilities to comply with a parent or teacher's request to nap are not

reflective of regulation. Commitment to one demand (e.g., take a nap) also precludes commitment to another (e.g., continue to play) because children cannot do both simultaneously. Finally, children must engage in volitional control over their thoughts and actions to suppress one option and activate the other without external help. The teacher/parent stopping the children from play and placing them in bed would not be considered self-regulation. Taken together, these three core components imply that self-regulation is *the ability to voluntarily control and direct emotions, actions, and cognitions in the presence of competing endogenously or exogenously triggered demands*.

Given the association between self-regulation and important long-term outcomes including academic achievement and social competence, a full understanding of how self-regulation develops in early childhood is necessary to inform prevention and intervention efforts (Moilanen et al., 2010). This understanding is gleaned from data produced by the numerous methods of measurement present in the developmental literature. Because the current understanding of self-regulation stems primarily from direct measures, it is important to explore how these measures assess self-regulation in early childhood. An evaluation of common measures of self-regulation may shed light on a task's potential to measure the multiple aspects of self-regulation and illuminate components of self-regulation that have yet to be studied using direct behavioral measures.

Direct Measures of Preschoolers' Self-Regulation

As the study of self-regulation continues to grow, so do the number of direct laboratory measures used to assess the construct of self-regulation (see Carlson, 2005, for

a comprehensive review). While a comprehensive discussion of laboratory tasks used to assess regulatory competency among preschool children is beyond the scope of this manuscript, a summary of four common tasks used to assess preschooler's self-regulation (the Marshmallow Task, the Grass/Snow Task, the Dimensional Change Card Sort Task, and the Head-to-Toes Task) is presented in Table 2. As one can see, while all of these tasks contain two response options, an assumed presence of conflict, and the need to simultaneously suppress one response while activating another without external help (if conflict is present), it is clear that these measurements only provide information on regulation between two options that are triggered by *exogenous* factors (e.g., an abstract rule imposed by a researcher). While these tasks provide valuable insight into how young children acquire and develop the ability to regulate exogenously triggered demands, as well as the influence of this ability on later outcomes, no direct measure, to my knowledge, currently exists that assesses regulation in the absence of exogenous demands among preschool children.

This is surprising because it is recognized that self-regulation can be triggered by both internal (endogenous) and external (exogenous) factors (Raffaelli, et al., 2010). Indeed, self-regulation during the preschool years is often endogenously triggered. For instance, as preschool children engage in collaborative play with their peers, they often regulate between competing urges to play with a desired toy immediately or share the toy and wait their turn. This regulatory dilemma typically unfolds in the absence of direct adult commands. If a preschooler has internalized the notions of sharing and taking turns, and at the same time desires to play with an attractive toy that is being used by another peer, the child experiences a regulatory dilemma in which s/he must regulate between

two conflicting response options: (a) take the toy away from the peer to immediately gratify the desire to play with the item and (b) wait until the peer's turn is over before playing with the toy. Regulation in this example is triggered endogenously; the child must regulate between an internalized standard and a competing desire without exogenous factors eliciting the response options (i.e., there is no teacher telling the child in that moment "you have to share"). Note that the trigger of the regulatory dilemma is specific to the regulatory episode itself. Indeed, a similar regulatory dilemma to the episode presented above could be triggered exogenously if the child desired to take the toy away from the peer and did not have the internalized desire to share but was told to do so by a care provider and did have the internalized standard of complying with adult instruction. In this context, the child must regulate between two *exogenously* triggered response options: (a) take the toy away from the peer to immediately gratify the desire to play with the item and (b) comply with the teacher's instructions to share.

A number of researchers have argued that parents in individualistic cultures emphasize the developmental goal of autonomy and encourage their children to become independent individuals (e.g., Tamis-LeMonda et al, 2007). This suggests that the ability to function autonomously is viewed as essential to adaptive functioning in westernized societies. Children who are unable to regulate between two endogenously triggered demands, like those described in the dilemma above, will likely need adult support to resolve the conflict between the two competing options. These children may be viewed as less autonomous or independent compared to peers who are able to regulate between two endogenously triggered demands, an ability likely called upon frequently as young children begin to take initiative and are granted more power and control over their

environments. Thus, the ability to regulate between two internally generated response options may support, and perhaps even be fundamental to, one's ability to function autonomously and independently.

Children's ability to regulate between endogenously triggered demands may differ from their ability to regulate between demands triggered by an exogenous factor. It is possible that this difference may underlie the reason why some children might demonstrate regulation in one context (e.g., with peers on the playground) but not in others (e.g., in the classroom). That is, the reason why some children, for example, may demonstrate strong regulatory ability while playing with peers on the playground (a context in which endogenously triggered regulation is likely needed) but cannot manage to inhibit their desire to yell out answers without raising their hand in the classroom (a context in which exogenously triggered regulation is likely needed) could be due to differences in the ability to regulate endogenously versus exogenously triggered response options.

The Current Study

The current study explores endogenously triggered self-regulation among a sample of preschool children. Although the development of self-regulation in early childhood has been well documented (e.g., Kochanska, et al., 2000; Raffaelli et al., 2010), most self-regulation studies utilizing laboratory measures tend to rely on tasks in which the competing response options are imposed overtly by the experimenter; that is, generated exogenously. To my knowledge, researchers have yet to examine children's ability to regulate competing response options that are generated endogenously (i.e., by the children themselves) through a laboratory task.

Because no other study has specifically focused on assessing both endogenously and exogenously triggered regulation via direct behavioral measures, it is not known if children's regulatory competency is influenced by response option genesis. It is possible that children's ability to regulate generalizes across these two forms of regulation, such that children who are able to execute regulation in one context are equally able to regulate in the other. It is also possible, however, that children's regulatory ability is specific to the genesis of the regulatory episode, such that children's ability to regulate between endogenously triggered demands differs from their ability to regulate between exogenously triggered demands. Thus, the primary goal of this study is to explore preschool children's self-regulation when triggered by both endogenous and exogenous factors.

Given the developmental nature of self-regulation (Bronson, 2000), it is expected that children's overall regulatory capacities will improve with age. With no previous studies specifically exploring response option genesis, there is no empirical data to

suggest whether age will interact with the type of response option genesis in the regulatory episode. There is evidence, however, of age-related differences in modes of attentional selection. Enns and Trick (2006) suggest that there is more age- related change in endogenous modes of attentional selection than in exogenous modes. It is possible that like attention, age-related differences will be apparent between endogenously and exogenously triggered regulation. It may be that the ability to regulate between endogenously triggered response options develops before the ability to regulate between exogenously triggered demands, or vice versa. It is equally as possible that these two abilities develop in tandem with one another, such that the ability to regulate between endogenously triggered demands emerges at the same point in development as does the ability to regulate between exogenously triggered response options. Thus, the secondary goal of this study is to explore the influence of age on preschool children's ability to regulate endogenously and exogenously triggered response options.

In order to accomplish these objectives, children's self-regulation was assessed using the *Pour Task* (Squires & Manfra, 2014). The *Pour Task* was designed to assess children's ability to regulate between both endogenously and exogenously triggered response options. Pilot data collected using this task were evaluated by independent coders. It was concluded that the *Pour Task* can reliably elicit endogenously and exogenously triggered regulation (Squires & Manfra, 2014).

Eliciting Endogenously and Exogenously Triggered Regulation in a Laboratory Setting

At the most basic level, a regulatory dilemma involves two contradictory response options that must come into direct conflict with one another. In laboratory settings, exogenously triggered regulatory dilemmas are most often created by pitting a prepotent response against an abstract rule (e.g., touch your head when told verbally to touch your toes). In these dilemmas, the two response options conflict and the child must exercise volitional control to inhibit his or her dominant behavior and execute behaviors congruent with the rule. Often in these tasks, at least one response option needed for regulation relies on the child's internalization of a socially approved behavior. For example, in order for the abstract rule given by the researcher to conflict with the child's prepotent behavior, a child must have internalized the standard of complying with the adult's demands. If the child has not internalized this standard, the abstract rule does not challenge the prepotent behavior because the child has no desire to follow the instructions of the adult. In this case, there is no competition between demands, and as a result, no regulatory dilemma. In order to elicit endogenously triggered regulation in a laboratory setting, an internalized standard should come in to direct contradiction with a second response option, and both response options facilitating the regulatory dilemma should be produced from within the child, without the researcher giving directives triggering the two conflicting options.

Assessing Endogenously and Exogenously Triggered Regulation Using the *Pour Task*.

Beginning around 12 months, children's ability to demonstrate an awareness of social demands, and to inhibit and activate actions and emotions accordingly, emerges (Kopp, 1982). By three, it is likely that children have internalized, and can demonstrate an awareness of, a variety of social demands. The *Pour Task,* which will be described more in the Methods section below, draws on a child's ability to inhibit and activate responses in accordance with the social demand of not spilling over when pouring liquid. To assess endogenously triggered regulation using the *Pour Task,* the presence of the internalized standard to not spill is first validated. Then, a competing response option is introduced such that the child must inhibit actions that conflict with behavior that is consistent with the social demand of not spilling over when pouring.

In an effort to validate the presence of this internalized standard, children are asked to pour from cups containing more liquid than a corresponding empty cup can hold (Assessment of Spill Avoidance—described below). To establish a second response that comes into direct competition with this standard, children first sort through cards to locate colored paint splashes, identify the color of the paint splash, and receive a reward from a prize bag of corresponding color (Color Identification and Card Sort—described below). After the association between locating a paint splash and receiving a reward is established, children pour two times (researcher pours three times) from cups with paint splashes on the inside bottom to empty cups of varying sizes and shapes (Empty-Reward Association—described below). The cups with paint splashes in this trial contained less water than the corresponding empty cups such that the children can pour all of the liquid

into the second cup without spilling. They were then able to see and identify the paint splash at the bottom of the first cup and receive a prize (reward), establishing an action tendency of revealing the inside bottom of the cup to receive a reward. In the *Endogenously Triggered Self-Regulation* test trial (described in more detail below), children are given a cup containing more liquid than the corresponding empty cup can hold. Thus, in the *Pour Task,* the internalized standard of not spilling over while pouring (response option A) and the action tendency of revealing the inside bottom of the cup to receive a reward (response option B) come into direct contradiction with one another.

To assess exogenously triggered regulation using the *Pour Task*, an abstract rule to stop pouring when directed to do so verbally (response option A) and the previously created action tendency of revealing the inside bottom of the cup and receive a reward (response option B) come into direct contradiction with one another. To validate the presence of response option A, compliance is assessed using a card pick-up activity (Compliance Clean-up-- described below). Without empirical validation of compliance, it would not be known if a regulatory dilemma occurs during this test trial, as desire to comply with adult instruction is necessary for the abstract rule to conflict with the action tendency of pouring to get a prize. The ability to inhibit the action tendency of revealing the inside bottom of the cup and cease pouring immediately when directed to do so is indicative of successful regulation during this test trial.

Methods

Participants

Data were collected from 48 children attending a university-affiliated preschool in the spring and summer of 2014. Participants ranged in age from 3.05 to 5.33 years, with a mean age of 4.23 years (*SD* = .78). Twenty-six participants (54.2%) were female. Thirty-two participants (66%) were identified as White/Caucasian. Although income data were not obtained, the director of the center confirmed that almost all of the children who attend this preschool are from middle-class homes.

Procedure and Measures

The experimenter administered the *Pour Task* and the *Marshmallow Task* to each child in one session lasting approximately 25 minutes. The assessments were completed at the child's preschool in a quiet, low stimuli assessment room. Sessions were videotaped and subsequently coded. Participants were brought into the assessment room and were asked to sit at a child-size table, catty-corner to the experimenter. As depicted in Figure 1, boxes containing 10oz pre-filled cups with varying liquid amounts, as well as corresponding empty cups of varying sizes, were located to the right of the researcher, away from the view of the participant. Colored cloth prize bags containing one reward each (e.g., bouncy ball) were kept in a chest to the right of the researcher. Two clear, plastic, empty "goodie bags" were placed on the table before each session began. Both the child and experimenter stored their rewards in these "goodie bags" as the *Pour Task* progressed. Children completed the preliminary trials of the *Pour Task* first, followed by

the test trials. After completing the two test trials of the *Pour Task,* children completed the *Marshmallow Task.*

The *Pour Task:* Preliminary Trials. Each trial was administered in the same order for all participants. Preliminary trials constituted approximately 10-15 minutes of the total task time.

***Color identification and card sort*.** The purpose of this preliminary trial was to assess the child's ability to identify six colors and to create an association between locating a paint splash and receiving a reward from a prize bag of corresponding color. In this preliminary trial, the child was shown six cards, each depicting a colored paint splash (blue, green, yellow, purple, white, and orange). The participant was shown each card, one at a time, and asked to identify each color verbally. This was to confirm that the child knew, and could verbally identify, the above mentioned colors. Once it was confirmed that the child was able to identify each color, s/he was given a deck of 15 4x4-inch black cards. Fourteen cards in the deck were blank (black), and one card depicted a colored paint splash on it. The card with the colored splash on it was shuffled in randomly. Upon locating and identifying the card with the colored paint splash, the participant was allowed to retrieve a reward (e.g., bouncy ball) from a prize bag of corresponding color.

The participant and experimenter took turns, sorting through a total of four decks each (15 cards in each of 8 decks). The experimenter and participant received a prize for each color, with the exception of the white paint splash. Doing so established an association between seeing/finding a color splash and receiving a prize. This also

established an association for not receiving a prize in the case of a white paint splash. Verbal confirmations of the child's understanding were solicited throughout this trial (e.g., "*You found blue! Do you know what that means?"*). Color identification was coded dichotomously (Y/N) for ability to verbally label all six colors. Card sort was coded dichotomously (Y/N) for demonstrated understanding of color/prize association.

Compliance Clean-up. The purpose of this trial was to assess the child's committed compliance to experimenter instruction. At the end of the previous trial, the child was asked to pick-up the cards left on the table from the Card Sort (approx. 120 cards). S/he was given two plastic storage bags and asked to clear off the table by putting the cards in the bags while the experimenter stepped out of the room. The experimenter left the room for no more than two minutes. The goodie bags containing both the experimenter's and child's toys were left in the room during this trial. Compliance to experimenter instruction was coded dichotomously (Y/N).

Assessment of Spill Avoidance. The purpose of this preliminary trial was to assess if the child had an internalized desire to avoid spilling over. As depicted in Table 3, this preliminary trial was made up of the first five pours, three of which were poured by the participant and two of which were poured by the experimenter (as to continue the turn taking established in the first preliminary trial). The child was presented with a series of three cups containing varying water (colored with white food coloring to look milky) amounts (6oz, 8oz, and 8oz) and three empty cups of varying size (5oz, 7oz, and 3oz). In

this trial, each cup contained more liquid than the corresponding empty cup was able to hold. The experimenter was not present during the last pour of this trial (Pour 5).

One at a time, the child was asked to "pour from here to there." No further directions were given. These directions were worded such that no quantity was implied (e.g., "pour this water from this cup to that cup" might have been interpreted as "pour *all* of the water from this cup to that cup"). During the experimenter's turn, the child was instructed to tell her "when to stop." This was used to further assess if the child had an internalized desire to avoid spilling over. Because spilling was possible on all pours in this preliminary trial, the child's natural response to cease pouring before the liquid spilled over (as well as stopping the experimenter before spilling over) on all pours was taken to indicate spill avoidance. If the child spilled over, or allowed the experimenter to spill over, on any pour during this preliminary trial, the child was assumed to *not* have internalized spill avoidance and not be a good candidate for exploring endogenously triggered regulation with this task. Internalized spill avoidance was coded dichotomously (Y/N).

This preliminary trial was also used as a baseline for comparing behaviors during the subsequent endogenously triggered regulation test trial. The behaviors demonstrated during Pour 5 of this trial were coded and compared to behaviors during the endogenous test trial, allowing for empirical validation of the presence of conflict during the endogenous test trial. Pour 5 was unique in that the water amount and cup size of this pour were identical to the water amount and cup size of the trial used to assess endogenously triggered regulation (Pour 11). As such, behavioral differences between Pour 5 and the *Endogenously Triggered Self-Regulation* test trial (Pour 11) were most

likely attributable to the presence of an endogenously triggered regulatory dilemma, as all other variables were methodologically constant across these two pours (e.g., cup size, water amount, directions) The presence of behavioral differences between baseline and the endogenous test trial was coded dichotomously (Y/N) by independent coders. Coders reached 100% agreement after the first round of coding. The child's general ability to pour without issue during this trial was also taken as evidence that spilling over on the subsequent test trial did not likely stem from motor ability.

Empty-Reward Association. The purpose of this preliminary trial was to build an association between emptying the cup to reveal a colored paint splash and receiving a reward. Through this association, an action tendency of pouring all of the liquid out of the cup to receive a prize was established during this trial. As indicated in Table 3, this preliminary trial was composed of Pour 6 through 10. Pour 7 and 9 were completed by the participant. Pour 6, 8, and 10 were completed by the experimenter, as to continue the turn taking established in the first preliminary trial. In these trials, the child was presented with two cups containing varying water (colored with white food coloring as to look milky) amounts (2oz and 8oz) and two empty cups of varying size (3oz and 10oz). Unlike the first five pours (*Assessment of Spill Avoidance*), each of these cups did not contain more liquid than the corresponding empty cup could hold. As such, spilling over was not a possibility during this preliminary trial. This adjustment was made to allow for the participant to empty all of the liquid from the cup without risk of spilling.

At the bottom of each cup was a colored paint splash, identical to those presented in previous trials. Upon emptying the liquid and identifying the color splash, a reward

(e.g., bouncy ball) was retrieved from a cloth prize bag of corresponding color (as in *Color Identification and Card Sort*). One at a time, the child was asked to pour "from here to there." No further directions were given. The association between color splash and reward had been previously established during *Color Identification and Card Sort* and thus, was easily transferred to this trial. Because spilling over was not be a possibility during this trial, the child did not have to contend with his or her internalized desire to avoid spilling.

The *Pour Task:* Test Trials. Each trial was administered in the same order for all participants. Test trials constituted approximately 5-10 minutes of the total task time.

***Endogenously Triggered Self-Regulation*.** The purpose of this test trial was to assess the child's ability to regulate between two endogenously triggered response options. As depicted in Table 3, Pour 11 was the first test trial. Note that the previous pours (preliminary trials 1, 2, and 3; Pours 1-10) established that the participant both had an internalized standard not to spill over and a response association of emptying the cup to receive a reward. In order for endogenously triggered regulation to be assessed, these response options (not spilling over and emptying the cup to receive a reward) needed to come in direct conflict without experimenter directives. As shown on the left side of Figure 2, the child was given a cup containing 8oz of liquid and an empty 3oz cup. As in all previous pours, the child was only given the directions to "pour from here to there." The experimenter left the room and, as depicted on the right side of Figure 2, the child could either respond by pouring all of the liquid out (spilling over) to reveal the paint splash, or the child could inhibit this action tendency in order to behave congruently with

the internalized standard of not spilling over. These actions were interpreted as indicating poor endogenously triggered regulation or successful endogenously triggered regulation, respectively.

Spilling over was coded dichotomously (Y/N). Overt behaviors (e.g., pouring style, actions/verbalizations during and after the pour) were coded in order to validate the presence of the desire to receive a prize. The presence of this desire was a necessary component of this trial. Without the desire to receive a prize, the child would not have likely experienced regulatory conflict during this trial because s/he would have likely not contended with the two response options (spilling over to get a prize or forfeiting the prize to not spill over). If this were the case, the child's behavior of not spilling over could not be interpreted as reflecting regulatory competency. Overt behaviors demonstrated during this test trial were then compared to those demonstrated during Pour 5 (*Assessment of Spill Avoidance*). Because the action tendency of emptying the cup to receive a reward was not present during that preliminary trial, differences in behaviors from Pour 5 to the endogenous test trial were coded and analyzed for the presence of a regulatory dilemma.

***Exogenously Triggered Self-Regulation*.** The purpose of this test trial was to assess the child's ability to regulate between competing response options that were triggered exogenously. As depicted in Table 3, Pour 13 was the second test trial. In this trial, illustrated on the left side of Figure 3, the participant was presented with 8oz of liquid in the pour cup and an empty 10oz cup. Note that in this trial, spilling over was not a possibility; the child once again (as in *Empty-Reward Association*) was able to empty

the cup without violating the internalized standard of not spilling over (as established in the second preliminary trial). Acting in accordance with the internalized standard of not spilling over was not a possible response option in this test trial.

To assess the participant's exogenous regulatory ability, the experimenter introduced a response option that directly conflicted with the child's action tendency of emptying the cup to receive a reward. Before the child was given the set of cups, the experimenter told the child that the rules of the activity were changing and that this time, s/he would be told by the experimenter when to stop pouring. Comprehension of this new rule was verified and the child was given the set of cups and once again told to "pour from here to there." As shown on the right side of Figure 3, the experimenter told the child to stop pouring well before the bottom of the cup was visible. The child's ability to inhibit his/her action tendency in order to behave in accord with the experimenter's demand was taken as a marker of exogenous regulation. The previous assessment of compliance was also used to validate the presence of conflict between the two response options. Ceasing to pour when directed to do so was coded dichotomously (Y/N).

Delay of Gratification-Pour. Next, children completed a pilot trial designed to assess exogenously triggered regulation over a delay period. In this trial, participants were presented with 8oz of liquid and an empty 10oz cup. Five different prize bags were placed on the table in front of the children. Children were told that if they could wait to pour until the experimenter returned (2 min), they would receive two prizes; one from the corresponding prize bag and one brought in by the experimenter. They were told that if they did not wait to pour until the experimenter returned, they could retrieve their own

prize from the corresponding prize bag if they were able to locate a paint splash at the bottom of the cup, but that they would not receive an additional prize upon the experimenter's return. Regardless of whether the children waited to pour, they received a prize from the experimenter upon her return.

During data collection, it was determined that the original instructions were confusing to children causing them to misinterpret what was being asked of them. Therefore, after 10 participants, the instructions were changed to be more specific about the behavior children were being asked to delay. Compared to the original instructions in which children were simply told to "wait to pour" until the experimenter returned, the adjusted instructions expanded on this by telling children to "wait to pour from here to there." The experimenter pointed to each cup when giving these instruction as to draw the children's attention to the cups and away from the prize bags on the table. After another 10 participants, it was concluded that only about half of the children approached the task as it was intended. While the protocol was changed slightly again such that the prize bags were placed on the table only after the instructions were given, the data collected during this test trial were deemed unreliable due to the various instructions and continual misinterpretation by children. As such, the data from this trial will not be used in subsequent data analyses. However, it is important to note that because this test trial involved giving children a prize after a delay period, it is likely that performance on the subsequent delay of gratification task (the *Marshmallow Task*) is not independent of how children performed on this trial and should be considered when interpreting the findings from the *Marshmallow Task.*

The *Marshmallow Task*. In this task (Mischel et al., 1989), the child was presented with one marshmallow to eat. Before the child was allowed to eat the marshmallow, the experimenter explained that she had to leave the room and that if the child waited to eat the marshmallow until she returned, s/he would receive two marshmallows instead of one. After a verbal rule check, the experimenter exited the room for two minutes. Ability to delay gratification for the two minutes was coded dichotomously (Y/N). Results from this task were compared to those obtained during the two test trials for validation purposes.

Post-hoc Analyses. To fully explore regulatory performance in the current sample, child-level variables often associated with self-regulation were seen as potentially valuable in further exploring the current data. It is possible that factors unrelated to response option genesis, such as inhibition, attentional focus, and vocabulary, may underlie potential differences in regulatory performance across trials. For example, because the exogenously triggered test trial requires children listen to and comprehend a verbal rule, children with higher vocabulary scores may do better on this trial not because of regulatory ability in this domain per se, but because they are better able to listen to and understand the verbal rule compared to their counterparts with lower vocabulary abilities. Thus, although not in the original study design, additional data were obtained from an unrelated study utilizing a sub-sample (N = 31) of the same participants in the current study from the same university-affiliated preschool. The additional data

included teacher report of child inhibition and attention and a standardized test of receptive vocabulary.

Results

Results of the preliminary test trials of the *Pour Task* are presented first, followed by the results for each test trial. After the results of each trial of the *Pour Task* are discussed, the results of the *Marshmallow Task* are presented. The influence of response option genesis and age on children's regulatory competency are then examined, followed by an exploration of associations among test trials.

Preliminary Test Trials

All participants completed each preliminary trial in order, beginning with *Color Identification and Card Sort,* followed by *Compliance Clean-up,* then *Assessment of Spill Avoidance,* and finally *Empty-Reward Association*. None of the children needed to complete any preliminary trials more than once to demonstrate the corresponding competency being assessed.

Color Identification and Card Sort. Color identification was coded dichotomously for ability to verbally label the six colors used in the *Pour Task*. All 48 participants were able to label the six colors when prompted for the color label by the experimenter. No child needed to be prompted more than once for the color label.

Participant's comprehension of the association between seeing/finding a color splash and receiving a prize was also coded dichotomously during the Card Sort portion of this preliminary trial. The researcher solicited verbal confirmations of the children's understanding of the color-prize association by asking each participant "*Do you know what that means*?" upon location of a card with a color splash on it. Children's

understanding was indicated by a correct response to this question (e.g., "*I get to pick a prize out of a purple bag*" after locating a card with a purple paint splash). All 48 children verbally demonstrated a clear understanding that when they saw a color, they received a prize. No participant needed to sort through more than three out of the four decks to demonstrate this understanding.

Compliance Clean-up. Compliance to experimenter instruction to clean the table by putting all the sorted cards in storage bags while the researcher stepped out of the room was coded dichotomously (Y/N). All 48 participants followed the researcher's instruction to clean up. Although not all children were successful at completely clearing off the table during the two minutes the researcher was out of the room, all participants demonstrated a clear, active attempt to do so by persisting at cleaning for the duration of the researcher's absence. Thus, all participants were coded as demonstrating compliance to researcher instruction.

Assessment of Spill Avoidance. Children's internalized standard of spill avoidance was coded dichotomously (Y/N) such that children who did not spill over themselves or allow the experimenter to spill over on any of the five pours during this preliminary trial were coded as having an internalized spill avoidance. Those participants who spilled over themselves or who allowed the experimenter to spill over on any pour during this preliminary trial were coded as *not* having an internalized spill avoidance. Of the 48 participants, 40 children (80%) demonstrated an internalized spill avoidance.

These 40 children ranged in age from 3.05 to 5.33 years, with a mean age of 4.20 years (*SD* = .78). Twenty-three (57%) of the 40 were female.

Comparatively, eight children (20%) failed to demonstrate an internalized spill avoidance. These eight children ranged in age from 3.05 to 5.23 years with a mean age of 4.41 years (*SD* = .88). Three (38%) of these eight children were female. An independent samples *t*-test was conducted to examine if any significant group differences in age were present between those who demonstrated spill avoidance and those who did not. No significant difference in age was found, $t\ (46) = .696$ *ns*.

A chi-square test was conducted to determine if internalized spill avoidance in males differed than females. The results were not significant, $\chi^2\ (1, N = 48) = 1.07$, *ns.* Because the criteria for completing the *Endogenous Test Trial* was that children have an internalized sense of spill avoidance, children who did *not* demonstrate internalized spill avoidance were not good candidates for exploring endogenously triggered regulation with the *Pour Task*. As a result, subsequent analyses included the 40 participants who demonstrated internalized spill avoidance.

Empty-Reward Association. Participants' understanding of the association between revealing the colored paint splash (by pouring all of the liquid out of the cup) and receiving a reward was coded dichotomously (Y/N). Similar to procedures in the *Color Identification and Card Sort* preliminary trial, the experimenter solicited verbal confirmations of the children's understanding of the association between revealing the colored paint splash at the bottom of the cup and receiving a reward. The experimenter asked participants "*Do you know what that means*?" upon them revealing the color splash

at the bottom of the cup. Children's understanding was indicated by a correct response to the question (e.g., "*I get to pick a prize out of a blue bag*" after pouring the liquid out of the cup and revealing a blue paint splash at the bottom of the cup). All 40 children verbally demonstrated an understanding of the association between revealing the colored paint splash at the bottom of the cup (by pouring all of the liquid out) and receiving a reward. No participant needed to pour from more than two of the three cups to demonstrate this understanding.

Test Trials

Those who demonstrated spill avoidance (N = 40) completed each test trial. The order of the test trials for the *Pour Task* was fixed such that endogenously triggered regulation was assessed first, followed by exogenously triggered regulation, and ending with the *Marshmallow Task*.

Endogenously Triggered Self-Regulation. Overt behaviors during this trial were coded to confirm the presence of the desire to receive a prize. Because children would not experience conflict between two response options without this desire, coding for behaviors that were representative of wanting to receive a prize was an important step in validating the presence of a regulatory dilemma within this test trial. Behaviors indicating desire included lifting the cup to look at the bottom, peering into the inside of the cup, and verbalizing discontentment with not being able to see the color at the bottom of the cup. For example, a female participant (4.7 years) poured approximately two of the eight ounces of liquid into the empty cup, stopped pouring, and unable to see the bottom inside

of the cup, raised the cup into the air above her head. She looked at the bottom outside of the cup after raising it above her head and said "a*ww."* She then set the cup down on table and said *"What color do I get?"* Following this verbalization, she turned her hands palm up and said again (louder and higher pitched), *"What color do I get? Aww man…I can't do it."* In more of a sing-songy voice, she again said *"I can't do it."* She then slammed her hands on the table and said, *"6-7-8-9!"* She began to snap her fingers but then picked the cup back up and began to pour again. As a result, she spilled over. Once she spilled over, she stopped pouring, placed the cup back on the table and said *"awwwww… what color do I get?"* (in a sing-songy voice). She began to snap her fingers again and continued to do so until the experimenter returned. This participant, and others like her, were coded as demonstrating behaviors representative of the desire to receive a prize. These behaviors were then compared to her behaviors during Pour 5, which served as a baseline.

During Pour 5, the example participant described above poured approximately two ounces of liquid into the empty cup, then placed the cup with the remainder of the liquid on the table. She placed her hands in her lap and did not pick up the cup for the duration of the time left in the room. She made no vocalizations during this period. Because the participant demonstrated behaviors indicative of a desire to receive the prize as well as displayed clear behavioral differences from Pour 5 to the endogenous test trial, she was coded as experiencing a regulatory dilemma during the endogenous test trial. All 40 children were coded by two independent raters as demonstrating behaviors indicative of a desire to receive a prize and showing differences in behavior between Pour 5 and this

test trial. Thus, it was concluded that all children experienced a regulatory dilemma during the endogenous test trial of the *Pour Task.*

Spilling over during this trial was coded dichotomously (Y/N). Eleven (28%) of the 40 children spilled over during this trial, failing to demonstrate behaviors indicative of endogenously triggered self-regulation. These 11 children ranged in age from 3.05 to 5.06 years with a mean age of 3.74 years (*SD* = .70), and six (55%) of them were female. Twenty-nine (72%) of the 40 children did not spill over during this trial, demonstrating behaviors representative of endogenously triggered regulation. These 29 children ranged in age from 3.10 to 5.33 years with a mean age of 4.37 years (*SD* = .78). Seventeen (59%) of these 29 children were female. An independent samples *t*-test was conducted to examine if any significant group differences in age were present between those who demonstrated endogenously triggered regulation and those who did not. Significant differences in age were found, $t\ (38) = -2.467$, $p = .018$. Those who demonstrated endogenously triggered regulation were .64 years older than those who did not demonstrate endogenously triggered regulation. A chi-square test was performed to determine if endogenously triggered regulation varied by sex. The results indicated that there was no sex difference between those who demonstrated and failed to demonstrate endogenously triggered regulation, $\chi^2\ (1, N = 40) = .054$, *ns.*

For those who did not demonstrate endogenously triggered regulation ($N = 11$), the time from pour initiation to spill over was coded and ranged from 2.76 seconds to 62.00 seconds ($M = 27.24$ seconds, $SD = 22.46$). Correlations were conducted to examine the relations between time, age, and sex. Time from pour initiation to spill over was significantly related to age, $r = .799$, $p = .003$, such that older children who spilled over

during this trial delayed spilling over for a longer period of time than their younger counterparts. Sex was not significantly related to time from pour initiation to spill over, $r_{point\text{-}biserial} = .039$, *ns*.

Exogenously Triggered Self-Regulation. Ceasing to pour when directed to do so by the experimenter (i.e., exogenously triggered self-regulation) was coded dichotomously (Y/N). Twelve (30%) of the 40 children did not comply with researcher directives during this trial, failing to demonstrate behaviors indicative of exogenously triggered self-regulation. These twelve children ranged in age from 3.07 to 4.73 years, with a mean age of 3.76 years (*SD* = .50). Seven (58%) of these 12 children were female.

The remaining 28 children (70%) did fully comply with experimenter directives during this trial, demonstrating behaviors representative of exogenously triggered regulation. These children ranged in age from 3.05 to 5.33 years with a mean age of 4.40 years (*SD* = .80). Sixteen (57%) of these 28 children were female. An independent samples *t*-test was conducted to examine if any significant group differences in age were present between those who complied with researcher directives during this test trial and those who did not. Significant differences in age were found, $t\ (38) = -2.519$, $p = .016$. Those who demonstrated exogenously triggered regulation were .63 years older than those who did not demonstrate exogenously triggered regulation. A chi-square test was performed to determine if complying with experimenter directives during the exogenous test trial differed by sex. The results indicated that there were no sex differences among those who did and did not demonstrate exogenously triggered regulation, $\chi^2\ (1, N = 40) = .005$, *ns.*

The *Marshmallow Task*. The ability to delay gratification (i.e., not eat the marshmallow for the duration of the trial) was coded dichotomously (Y/N). Thirty children (75%) were able to delay gratification for the duration of this trial. These 30 children ranged in age from 3.07 to 5.33 years, with a mean age of 4.30 years (*SD* = .75). Fourteen (46%) of the 30 children who delayed gratification were female.

Ten children (15%) were not able to delay gratification. These ten children ranged in age from 3.05 to 5.14 years, with a mean age of 3.91 years (*SD* = .72). An independent samples *t*-test was conducted to examine if any significant group differences in age were present between those who delayed gratification and those who did not. No significant differences in age were found, $t\ (38) = -1.385$, *ns*. A chi-square test was performed to determine if the ability to delay gratification during this test trial differed by sex. The results indicated that more boys demonstrated the ability to delay gratification compared to girls, $\chi^2\ (1, N = 40) = 5.763$, $p = .016$. Nine (90%) of the 10 who could not delay gratification were female.

Among those who did not delay gratification ($N = 10$), the average time of delay before eating the marshmallow was 17.71 seconds (*SD* = 34.23 seconds) with a range from 2.47 seconds to 108 seconds. A correlation was conducted to explore the relations between time of delay before failure, age, and sex. Time of delay before failure was not significantly related to age, $r = -.314$, *ns*, nor sex, $r_{point\text{-}biserial} = -.025$, *ns*.

The Influence of Response Option Genesis on Children's Regulatory Competency

Nineteen (47.5%) of the 40 children demonstrated regulation on one test trial but not the other (i.e., either endogenous or exogenous, but not both). This suggests that the genesis of the response options may impact preschool children's ability to demonstrate behaviors indicative of self-regulation. The nineteen children who demonstrated regulation on one test trial but not the other ranged in age from 3.05 to 5.06 years, with a mean age of 3.84 years (*SD* =.60). Eleven (58%) of these 19 children were female. A different group of nineteen (47.5%) out of 40 children demonstrated regulation on both the endogenous and exogenous test trials. These children ranged in age from 3.33 to 5.33 years, with a mean age of 4.65 years (*SD* =.70). Eleven (58%) of these 19 children were female. The remaining two children (5%) did not demonstrate regulation on either trial. Because this last group has only two children, it is too small to be included in subsequent group-comparison analyses.

An independent samples *t*-test was conducted to explore if significant age differences were present between those who demonstrated regulation on both test trials of the *Pour Task* and those who demonstrated regulation on only one test trial. Significant differences in age were found, $t\,(36) = 3.854$, $p < .001$. On average, those who demonstrated regulation on both test trials were .82 years older than those who demonstrated regulation on only one test trial. A chi-square test was performed to determine if more girls or boys were able to regulate during both test trials versus only one test trial. No significant differences were found, $\chi^2\,(1, N = 38) = .000$, *ns*.

Of the 19 children who demonstrated regulatory competency on only one test trial in the *Pour Task*, 10 children (53%) demonstrated regulation on the endogenous test trial

but not on the exogenous test trial (mean age = 3.84 years, *SD* = .50). The remaining nine children (47%) demonstrated regulation on the exogenous test trial but not on the endogenous test trial (mean age = 3.83 years, *SD* = .74).

A one-way ANOVA was conducted to examine if significant group differences in age were present among those who demonstrated regulation on both test trials, those who demonstrated regulation on the endogenous test trial but not the exogenous test trial, and those who demonstrated regulation on the exogenous test trial but not on the endogenous test trial. The overall model for age was significant, F (2, 35) = 6.372, p = .002. Post hoc comparisons indicated that the mean age of those who demonstrated regulation on both trials (M = 4.65 years, *SD* =.70) was significantly higher than those who demonstrated regulation on the endogenous test trial but not on the exogenous test trial (M = 3.84, *SD* = .50). On average, children who demonstrated regulation on both test trials were .81 years older than those who demonstrated regulation on only the endogenous test trial (p = .008). The mean age of those who demonstrated regulation on both test trials was also significantly higher than those who only demonstrated exogenously triggered regulation (M = 3.83 *SD* = .74). Children who demonstrated regulation on both test trials were, on average, .83 years older than those who demonstrated regulation on only the exogenous test trial (p = .012). No significant age differences were present between those who only demonstrated endogenously triggered regulation and those who only demonstrated exogenously triggered regulation. A multinomial logistic regression was conducted to examine if the likelihood of demonstrating regulation on both test trials, only on the endogenous trial, or only on the exogenous trial was related to sex. The overall model

results for sex were not significant χ^2 (2, N = 38) = .038, *ns*, indicating that sex did not influence group membership.

The Influence of Age on Children's Regulatory Competency

Given that significant age differences between groups emerged, scatter plots were created to look at distributions of age for success and failure on test trials. Based on the scatter plots, there seemed to be a transition from not demonstrating regulation to demonstrating regulation at approximately four years of age. Thus, to explore whether there were differences in performance for children under four years compared to those over four years, a categorical age variable was created that split the sample into "young" (less than four years) and "old" (four years or greater) groups. Using this categorical variable, chi-square analyses were conducted to explore if demonstration of endogenously triggered regulation, exogenously triggered regulation, and regulation on both test trials was more likely with older children compared to younger children.

The results for all these analyses were significant. Findings indicated that 85% of the older children and 58% of the younger children demonstrated endogenously triggered regulation, χ^2 (1, N = 40) = 3.872, ϕ = .311, p = .049. Similarly, 86% of the older children and 53% of the younger children demonstrated exogenously triggered regulation, χ^2 (1, N = 40) = 5.199, ϕ = .361, p = .023. Finally, findings indicated that 71% of older children and only 24% of younger children demonstrated regulation on both test trials, χ^2 (1, N = 38) = 8.622, ϕ = .476, p = .003.

A chi-square was also conducted to explore if older children were more likely to demonstrate regulation on both test trials, only the exogenously triggered test trial, or

only the endogenously test trial compared to younger children. Results indicated that the percentage of older children who demonstrated regulation on both test trials was significantly higher than the percentage of older children who demonstrated only endogenously triggered regulation or only exogenously triggered regulation, χ^2 (1, N = 38) = 8.643, ϕ = .477, p = .013. Interestingly, of the nine children who demonstrated endogenously triggered regulation but not exogenously triggered regulation, six (67%) were younger than four years of age. Of the 10 children who demonstrated exogenously triggered regulation but not endogenously triggered regulation, 7 (70%) were below the age of four. Thus, while the percentage of older children who demonstrated regulation on both test trials was significantly higher than the percentage of older children who demonstrate only endogenously triggered regulation or only exogenously triggered regulation, the distribution of age for those who demonstrated only endogenously triggered regulation or demonstrated only exogenously triggered regulation was remarkably similar.

Associations among Test Trials

Chi-square analyses were conducted to examine the relations among passing/failing endogenously triggered self-regulation, passing/failing exogenously triggered self-regulation, and passing/failing delay of gratification. The relation between performance on endogenously triggered self-regulation and on exogenously triggered self-regulation was not significant, χ^2 (1, N = 40) = 1.009, *ns*. Those who demonstrated regulation during the endogenous test trial were not significantly more likely to demonstrate regulation during the exogenous test trial. The relation between performance

on endogenously triggered self-regulation and ability to delay gratification during the *Marshmallow Task* was also not significant, χ^2 (1, N = 40) = 3.386, *ns.* Thus, performance on the endogenous test trial was not significantly related to children's ability to delay gratification; that is, those who demonstrated regulation on the endogenous test trial were not more or less likely to demonstrate delayed gratification compared to those who did not demonstrate endogenously triggered regulation. Similarly, the relation between exogenously triggered self-regulation and the ability to delay gratification was not significant χ^2 (1, N = 40) = 2.540, *ns*, indicating that children's ability to regulate between two exogenously triggered response options was not related with their ability to delay gratification.

Post-hoc Analyses

After contacting the Primary Investigator of this other study, permission to use child inhibition, attention, and vocabulary scores in post-hoc analyses for this study was granted (F. Palermo, personal communication, August 20, 2014). The results of these analyses are presented below.

Inhibition. A score of children's ability to plan and suppress inappropriate responses was derived by summing items on the inhibitory control subscale of the Children's Behavior Questionnaire (CBQ; Putnam & Rothbart, 2006). Inhibition scores were obtained for 31 of the 38 participants in the original sample. Three independent samples *t*-tests were conducted to examine if group differences in inhibition were present between those who demonstrated endogenously triggered regulation and those who did

not, those who demonstrated exogenously triggered regulation and those who did not, and those who demonstrated regulation on both test trials and those who demonstrated regulation on only one. No significant differences in inhibition emerged between those who did and those who did not demonstrate endogenously triggered regulation, t (29) = -.637, *ns*, between those who did and those who did not demonstrate exogenously triggered regulation t (29) = .800, *ns*, or between those who demonstrated regulation on both test trial and those who only demonstrated regulation on one, t (29) = -.133, *ns.* A multinomial logistic regression was conducted to examine the relation among inhibition, demonstration of regulation on both test trials, demonstration of regulation only on the endogenous trial, or demonstration of regulation only on the exogenous trial. The overall model results for inhibition were not significant χ^2 (2, N = 31) = .877, *ns*, further indicating that inhibition does not explain patterns of success and failure on the endogenous and exogenous test trials

Attentional Focus. A score of children's tendency to maintain attentional focus on a task was derived by summing items on the attentional focus subscale of the CBQ (Putnam & Rothbart, 2006). Attentional focus scores were obtained for 31 of the 38 participants in the original sample. Three independent samples *t*-tests were conducted to examine if group differences in attentional focus were present between those who demonstrated endogenously triggered regulation and those who did not, those who demonstrated exogenously triggered regulation and those who did not, and those who demonstrated regulation on both test trials and those who demonstrated regulation on only one. No significant differences in attentional focus were present between those who

did and those who did not demonstrate endogenously triggered regulation, t (29) = .130, *ns*, between those who did and those who did not demonstrate exogenously triggered regulation, t (29) = .952, *ns*, or between those who demonstrated regulation on both test trial and those who only demonstrated regulation on one, t (29) = -.910, *ns*. A multinomial logistic regression was conducted to examine the relation among attentional focus, demonstration of regulation on both test trials, demonstration of regulation only on the endogenous trial, or demonstration of regulation only on the exogenous trial. The overall model results for attentional focus were not significant χ^2 (2, N = 31) = 1.173, *ns*, further indicating that success and failure on exogenous and endogenous test trials was not dependent on children's level of attentional focus.

Vocabulary. A score of children's receptive vocabulary was derived from the Peabody Picture Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2007). Age-graded PPVT-IV scores were obtained for 27 of the 38 participants in the original sample. Three independent samples *t*-tests were conducted to examine if group differences in receptive vocabulary were present between those who demonstrated endogenously triggered regulation and those who did not, those who demonstrated exogenously triggered regulation and those who did not, and those who demonstrated regulation on both test trials and those who demonstrated regulation on only one. No significant differences in receptive vocabulary were present between those who did and those who did not demonstrate endogenously triggered regulation, t (25) = -1.414, *ns*, between those who did and those who did not demonstrate exogenously triggered regulation, t (25) = .245, *ns*, or between those who demonstrated regulation on both test trials and those who only

demonstrated regulation on one, t (25) = 1.010, *ns.* A multinomial logistic regression was conducted to examine the relation among vocabulary, demonstration of regulation on both test trials, demonstration of regulation only on the endogenous trial, or demonstration of regulation only on the exogenous trial. The overall model results for receptive vocabulary were not significant χ^2 (2, N = 27) = 1.868, *ns*. These findings suggest that vocabulary does not predict success and failure on the endogenous and exogenous test trials.

Discussion

The current study was designed to explore preschoolers' ability to regulate endogenously and exogenously triggered response options using a direct behavioral measure in a controlled laboratory setting. The influence of age on preschool children's endogenously and exogenously triggered regulation was also explored. Nearly all the children in this sample demonstrated the ability to regulate on at least one of the regulation trials. For almost half of the participants in this study, the ability to regulate depended on the genesis of the response options. For these children, self-regulation in one domain (e.g., endogenous) did not necessitate regulatory ability in the other domain (e.g., exogenous). Regulatory competency was related to age such that a significantly higher number of children four years or older demonstrated endogenously triggered regulation compared to children under four years. There was also a significantly higher number of older children who demonstrated exogenously triggered regulation compared to younger children. Further, a large majority (71%) of older children demonstrated regulation on *both* test trials, while a large majority (76%) of younger children demonstrated regulation on only *one* of the two test trials. No age differences emerged between those who demonstrated endogenously triggered regulation but not exogenously triggered regulation and vice-versa. Post-hoc analyses revealed that inhibition, attentional focus, and receptive vocabulary did not explain patterns of success and failure on the endogenous and exogenous test trials.

The *Pour Task*

Despite recognition within the literature that regulatory episodes can be triggered by internal factors, the *Pour Task* is the first direct behavioral assessment of children's endogenously triggered regulation. The ability of the *Pour Task* to assess preschool children's endogenously triggered regulation is high. All children in this sample demonstrated the motor ability to pour liquid from one cup to another. Eighty percent of the total sample demonstrated an internalized spill avoidance. All of the children who demonstrated an internalized spill avoidance were coded as experiencing a regulatory dilemma during the endogenous test trial. Thus, the evidence from the present study suggests that *Pour Task* is a valid measure of endogenously triggered regulation and is appropriate for use among preschool populations.

The existing direct measures of self-regulation reviewed in this manuscript only assume the presence of two competing responses. A major methodological strength of the *Pour Task* is that the presence of the two competing options necessary for regulation to occur is validated within the task protocol. For example, in the endogenously triggered test trial, children must contend with the desire to not spill over and with the desire to reveal a paint splash and receive a reward. The desire to avoid spilling over was validated in the *Assessment of Spill Avoidance.* Additionally, behaviors during the endogenously triggered test trial were coded and compared to a baseline, allowing for validation of the presence of conflict between the two response options in this test trial. All children who demonstrated spill avoidance also demonstrated behavioral differences from baseline to test trial, suggesting that the *Pour Task* reliably elicits conflict between two endogenously triggered response options. To validate the presence of competing response

options in the exogenously triggered test trial, compliance was assessed during *Compliance Clean-up.* All children in this sample demonstrated a desire to comply to with experimenter directives. Without this validation, it would be difficult to determine if children were in fact experiencing regulatory conflict between continuing to pour and stopping when directed to do so by the experimenter.

Endogenously and Exogenously Triggered Regulation

Seventy-two percent of children demonstrated endogenously triggered self-regulation. This suggests that, in general, preschool children possess the ability to regulate between two internally generated response options. Seventy percent of children demonstrated exogenously triggered regulation. Thus, like endogenously triggered regulation, the ability to regulate between two exogenously triggered response options is present during the preschool period. As expected, more older children (4 years or older) were able to demonstrate endogenously triggered regulation, exogenously triggered regulation, and regulation across both test trials compared to younger children (younger than 4 years). For those who did not demonstrate endogenously triggered regulation, the time from pour initiation to spill over was significantly related to age such that the time from pour initiation to spilling over increased with age.

Interestingly, while nearly all children demonstrated some form of regulatory competence, almost half of children (three-quarters of whom were under four years) varied in regulatory ability by response options genesis; some were able to demonstrate endogenously triggered regulation but not exogenously triggered regulation and others were able to demonstrate exogenously triggered regulation but not endogenously

triggered regulation. Of those who demonstrated regulation on only one test trial, 53% did so on the endogenously triggered regulation trial but not the exogenously triggered regulation trial. The remaining 47% of children demonstrated exogenously triggered regulation but not endogenously triggered regulation.

These findings suggest that the ability to regulate between endogenously triggered demands and the ability to regulate between exogenously triggered demands may represent domain specific cognitive abilities. That is, endogenously triggered regulation and exogenously triggered regulation may implicate separate cognitive regulatory systems or modules. Domain specificity is further supported by the finding that those who demonstrated regulation during the endogenous test trial were not more likely to demonstrate regulation during the exogenous test trial and vice-versa. That is, almost half of the children in this study demonstrated regulatory competency within but not across domains. If endogenously and exogenously triggered regulation were controlled by general cognitive modules, regulatory competency in one domain would likely be significantly associated with regulatory competency in the other domain, resulting in a high correlation between performance on the endogenous and exogenous test trials. No such association was found in the present investigation. These results may help with the understanding of self-regulation in early childhood and may be important to consider when designing prevention and intervention curriculum for young children with regulatory deficits.

Although age differences were present between those who demonstrated regulation on both test trials and those who only demonstrated exogenously or endogenously triggered regulation, no differences in age were present between those who demonstrated

only endogenously triggered regulation and those who demonstrated only exogenously triggered regulation. This suggests that while regulatory competency in both domains may develop after regulatory competency in one domain, the ability to regulate between endogenously triggered response options does not develop before the ability to regulate between exogenously triggered demands, and vice versa. These findings are different from those presented in studies exploring attentional selection, which demonstrate greater age-related change for endogenous modes of attention (Enns & Trick, 2006). This suggests that the developmental trajectory of children's self-regulation may be different from that of other cognitive processes, like attention.

No differences in sex were present between those who did and did not demonstrate endogenously triggered regulation, those who did and did not demonstrate exogenously triggered regulation, those who demonstrated regulation on both test trials and those who only demonstrated regulation on one, and between those who demonstrated only endogenously triggered regulation and those who demonstrated only exogenous triggered regulation. Although some studies have found gender differences in self-regulation (e.g., Kochanska et al., 2001; Ponitz et al., 2008), these differences are often marginal and the effect sizes are small. These results replicate previous findings on gender differences, as most research indicates boys and girls develop self-regulation at similar rates during early childhood (Anderson, 2002).

Post-hoc analyses were conducted to explore the relations among inhibition, attentional focus, receptive vocabulary, and regulatory skills. Several researchers have concluded that higher levels of inhibition, attention, and vocabulary may be related to greater regulatory ability (e.g., Carlson & Wang, 2007). In this study, children's

inhibition, attention, and vocabulary did not relate to performance on endogenously and exogenously triggered regulation. No group differences in inhibition, attentional focus, and vocabulary were present between those who demonstrated endogenously triggered regulation and those who did not, or between those who demonstrated exogenously triggered regulation and those who did not. Similarly, no group difference in inhibition, attentional focus, and vocabulary were found between those who demonstrated regulation on both test trials and those who demonstrated regulation on only one.

These findings were somewhat surprising given that age was significantly related to performance. Other unmeasured factors that increase with age, such as cognitive flexibility or working memory, may produce differences in children's ability to demonstrate endogenously and exogenously triggered regulation, as well as regulation in both contexts. It may also be that older children simply have more practice regulating in both contexts, and thus, are more likely to demonstrate regulation during each test trial and across trials.

Additionally, no differences in inhibition, attentional focus, and vocabulary emerged between those who demonstrated endogenously triggered regulation but not exogenously triggered regulation and those who demonstrated exogenously triggered regulation but not endogenously triggered regulation. When partnered with the findings that those who demonstrated only endogenously triggered regulation did not differ in age from those who demonstrated only exogenously triggered regulation, these results present an interesting puzzle: why can some children regulate in one domain but not the other?

Differences in parenting practices (e.g., parental scaffolding, parenting style) may be one possible reason some children were able to regulate in one domain but not the

other. Researchers examining the origins of self-regulation have suggested that the ability to voluntarily control and direct one's actions, emotions, and cognitions unfolds largely in the social context of family (see Carlson, 2009 for a review). Because regulatory competency develops in large part through social interactions within the family, differences in family socialization processes, including parenting practices, may create differences in children's ability to regulate in one domain but not the other. This possibility may help guide future scholarly investigations examining social antecedents of children's self-regulation.

Taken together, the results of this study indicate that the majority of preschool children are able to regulate between response options that are either endogenously or exogenously triggered. This conclusion is in line with recent research suggesting the ability to regulate one's actions, thoughts, and emotions develops rapidly within the first 5 years of life (e.g., Raffaelli et al., 2010). These findings also extend the understanding of self-regulation by demonstrating that the ability to regulate between endogenously triggered demands is present during the preschool period and can be measured by a direct behavioral measure. Based on this evidence, it may be reasonable to conclude that the current understanding of self-regulation from direct measures is quite limited in that children's ability to regulate endogenously triggered demands is largely unaccounted for. Utilizing laboratory tasks, such as the *Pour Task,* to measure both endogenously and exogenously triggered regulation in a controlled setting provides valuable insight into children's regulatory competency.

Prior to this study, the knowledge of self-regulation from direct measures only addressed children's ability to regulate exogenously triggered demands. Several children

in this study demonstrated the ability to regulate endogenously triggered demands but not the ability to regulate exogenously triggered demands. These children, in any other study utilizing direct behavioral assessments, would likely be classified as not possessing overall regulatory ability. This would be an inaccurate estimation of their actual regulatory skills, as the findings from the current study indicate that children who fail to demonstrate exogenously triggered regulation did not fail to demonstrate endogenously triggered regulation. It is possible that children in other studies, if given a task with endogenously triggered response options, would demonstrate more regulatory competence than what would be concluded by only using a classic exogenously triggered regulation task.

Implications and Future Directions

The current study provides a method for assessing endogenously triggered regulation using a direct behavioral measure. Given the results of this investigation, assessing both endogenously and exogenously triggered regulation seems important for understanding the full scope of children's regulatory competency. This notion may be especially important to consider when thinking about the current literature on regulatory competencies of children in at-risk populations. A number of researchers have concluded that children from low-income families have lower regulatory skills than their economically-advantaged peers (e.g., Blair, 2010; Blair & Raver, 2012; Bradley & Corwyn, 2002; Raikes, Robinson, Bradley, & Ayoub, 2007; Wanless, McClelland, Tominey, & Acock, 2011). For example, using the Head-to-Toes task to explore the influence of demographic risk factors on children's regulation, Wanless et al. (2011)

concluded that children from low-income families begin prekindergarten with significantly lower self-regulation than their economically advantaged peers. It may not be the case that children situated in the context of poverty have lower regulatory skills overall. Because the Head-to-Toes task requires children to regulate between two exogenously triggered response options, it may be that children living in poverty are less likely to demonstrate exogenously triggered regulation but do have the ability to regulate when the conflicting response options are triggered internally.

Without an assessment of children's endogenously triggered regulation, it may not be prudent to make assertions about overall regulatory ability. It is possible that the current literature underestimates the regulatory skills of children, including those in at-risk populations. Future research exploring endogenously and exogenously triggered regulation with diverse samples will provide more insight into this possibility. The results presented in this study highlight the importance of assessing regulation that is triggered by both endogenous and exogenous factors before drawing conclusions about children's overall regulatory competency.

If regulatory skill during the preschool period does in fact depend on the genesis of the response options, prevention and intervention programs designed to target regulation in both contexts will likely be most successful in improving overall regulatory competency. Indeed, several programs that have been shown to increase children's self-regulation seem to include curricula that work towards fostering both endogenously and exogenously triggered regulation. For example, the Tools of the Mind curriculum, which has been shown to enhance academic achievement through improving regulatory skills (see Urasche, Blair, & Raver, 2012 for a review of this program and others like it), is

designed to promote children's ability to take turns, use self-regulatory private speech, understand the perspectives of others, and monitor their peers and themselves simultaneously (Diamond, Barnett, Thomas, & Munro, 2007). This curriculum likely fosters abilities that aid in the regulation of both endogenously and exogenously triggered demands.

As mentioned in the introduction, children in preschool may grapple with conflicting options of taking a toy away from their peer to immediately gratify their desire to play with the item and waiting until their peer's turn is over before playing with the toy. Regulation in this example is triggered endogenously; the child must regulate between an internalized standard and a competing desire without exogenous factors eliciting the response options. Turn taking strategies fostered by the Tools curriculum may help children demonstrate endogenously triggered regulation in this context, such that children who are able to utilize these strategies can adaptively resolve the conflict between these two competing options.

Often, preschool children are asked to comply with caregiver requests to stop one activity (e.g., playing) in order to begin another (e.g., napping). Regulation in this example is triggered exogenously, as the caregivers request generated the competing options of continuing to play and complying with caregiver directives to nap. Increased ability to use self-regulatory speech, as fostered by the Tools curriculum, may improve children's exogenously triggered regulation in this context by helping children inhibit their desire to continue playing while increasing their attentional focus to the request of the care provider. If the ability to exercise regulation does in fact depend on the genesis of the response options, the most successful prevention and intervention curriculas may

be those that provide children with strategies to facilitate regulatory competency in both domains.

Limitations

Given the preliminary nature of this study, caution should be taken when interpreting and drawing conclusions about the presented findings. This study is the first to assess endogenously and exogenously triggered regulation using the *Pour Task.* Before findings can be assumed to generalize to all preschoolers, more research needs to be conducted in an effort to replicate the results found in the current study. This research should include more socioeconomically and ethnically diverse children. Indeed, a major limitation of the current study is the homogeneity of the sample. Most children were White and from middle-class homes. Because of this, the generalizability of these findings is limited and it is not known if performance on endogenously and exogenously triggered regulation varies based on important variables like race and socioeconomic status. The size of the sample is also a limitation of the current study, with some groups used in analyses containing as few as nine children. Such small groups may have decreased the likelihood of detecting effects (Type II error).

Another limitation of the present study is the fixed nature of the trial order. Because all trials were given in the same order for all participants, it is not known if performance on one trial systematically influenced performance on subsequent trials. Notably, the fixed order of the trials may have influenced performance on the *Marshmallow Task.* Although it was expected that performance on the *Marshmallow Task* would be associated with performance on the exogenously triggered regulation trial because both ask children to regulate between two externally generated response options,

performance on the *Marshmallow Task* was not related to performance on the exogenously triggered test trial. It may be that performance on the *Marshmallow Task* was influenced by the preceding pilot task in which children were asked to delay pouring, and as a result, expected patterns of performance were not observed. Because of the fixed order of the test trials, the results from the *Marshmallow Task* may be biased and should be interpreted cautiously.

It is worth noting, however, that it is equally as possible that performance on the *Marshmallow Task* was not associated with performance on the exogenously triggered test trial because although both required children to regulate between two exogenously triggered demands, the *Marshmallow Task* required children to do so over a delay period. If the presence of a delay period was the factor determining children's regulatory performance, one may expect performance on the *Marshmallow Task* to be statistically related to performance on the endogenously triggered test trial, as they both required children to regulate over a delay. No such association was found. More research needs to be conducted to help separate the influence of the varying trial components on children's ability to demonstrate regulation.

An additional limitation of this study is that the validation of children's compliance during the *Compliance Clean-up* preliminary trial assessed children's committed compliance (i.e., children's wholehearted endorsement of a request such that they take on the request as their own; Kochanska et al., 2001). The exogenously triggered test trial likely called upon children's situational compliance (i.e., complying with a request because of the presence of an authority figure; Kochanska et al., 2001). Several researchers have reported differences in children's ability to comply based on type of

compliance (Wachs, Gurkas, & Kontos, 2004). Thus, although all children demonstrated committed compliance, it is possible that they might not have demonstrated situational compliance. If that were true for some children, then it is also possible that those children may not have experienced the same degree of assumed conflict during the exogenous test trial.

These data are also limited because endogenously triggered regulation was only evaluated by one test trial. It is not known if performance would have remained consistent across multiple test trials assessing endogenously triggered regulation. These data are further limited due to the limited use of varying tasks to assess regulation. Only the *Pour Task* was used to assess endogenously triggered self-regulation, and only the *Pour Task* and the *Marshmallow Task* were used to assess exogenously triggered regulation. It is not known if similar results would be replicated across varying tasks or if these results are specific to the tasks used in this study. To obtain a more complete understanding of children's endogenously and exogenously triggered regulatory competencies, future research should incorporate the assessment of regulation across multiple trials and tasks.

Despite these limitations, the current investigation provided valuable insight into children's endogenously triggered regulation using a direct behavioral measure. Evidence from the current study suggests that preschool children have the ability to regulate endogenously and exogenously triggered response options, and that for some children, this ability depends on the genesis of the response options. Future research should be designed to replicate these findings in larger, more diverse samples. Future investigations

should also attempt to uncover the possible mechanisms that foster regulatory ability in one domain but not the other.

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Appendices

Table 1
Terms

Term	Definition	Source
Self-regulation	*"The ability to comply with a request, to initiate and cease activities according to situational demands, to modulate the intensity, frequency, and duration of verbal and motor acts in social and educational settings, to postpone acting upon a desired object or goal, and to generate socially approved behavior in the absence of external monitors"* (p.199).	Kopp, C. B. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18*, 199-214.
	"*The internally directed capacity to regulate affect, attention, and behavior to respond effectively to both internal and environmental demands"* (p. 56).	Raffaelli, M., Crockett, L. J., & Shen, Y. (2010). Developmental stability and change in self-regulation from childhood to adolescence. *The Journal of Genetic Psychology, 166*, 54-76.
Self-control	*"The voluntary ability to postpone immediate gratification and persist in goal directed behavior for the sake of later outcomes"* (p.933).	Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science*, 933-937.
Effortful control	*"The efficiency of executive attention, including the ability to inhibit a dominant response and/or activate a subdominant response, to plan, and to detect errors*" (p.129).	Rothbart, M.K., & Bates, J.E. (2006) Temperament. In: Eisenberg, N., ed. Social, emotional, and personality development. New York, NY: Wiley. Damon W, ed. Handbook of Child Psychology. 6th ed; vol 3.
Cognitive control	*"The ability to select a weaker, task-relevant response (or source of information) in the face of competition from an otherwise stronger, but task-irrelevant one"* (p.170).	Miller, E., & Cohen J. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167-202.
Inhibitory control	*"The capacity to plan and effortfully suppress inappropriate approach responses under instructions or in novel or uncertain situations"* (p.682).	Eisenberg, N., Valentine, C., & Eggum, N. D. (2010). Self-regulation and school readiness. *Early Education and Development, 21*, 681-698.
Common Components Across Definitions	**1. The presence of two or more endogenously or exogenously triggered demands/response options in the regulatory dilemma** Examples: "*…to initiate and cease activities according to* ***situational demands****…"* (Kopp, 1982) "*…inhibit a* ***dominant response*** *and/or activate a* ***subdominant response****…"* (Rothbart & Bates, 2006) "*…to select a weaker,* ***task-relevant response****…from an otherwise stronger, but* ***task-irrelevant one****."* (Miller & Cohen, 2001) "*…respond effectively to both* ***internal*** *and* ***environmental*** *demands."* (Raffaelli et al., 2010)	
	2. Competition between the demands, such that commitment to one demand precludes commitment to a second demand Examples: "*…in the face of* ***competition*** *from an otherwise stronger…"* (Miller & Cohen, 2001) "*…capacity to…* ***suppress inappropriate approach responses*** *under instructions…"* (Eisenberg, Valentine, & Eggum, 2010) Note: The notion of competition among demands is implied, as each definition indicates the need to suppress or inhibit a response. Without competition among demands, the need to suppress or inhibit would not be present.	
	3. Volitional control over thoughts and actions, such that the simultaneous suppression of one response and the activation of another is achieved without external influence Examples: "*…to generate socially approved behavior in the* ***absence of external monitors****…"* (Kopp, 1982) *"****The voluntary ability*** *to postpone immediate gratification and persist in goal directed behavior…"* (Mischel, Shoda, & Rodriguez, 1989).	

Table 2

Task Evaluations

Task	**Description**	**Two(+) demands (response options)**		**Endogenously or exogenously triggered**	**Conflict resulting from competition between response options**	**Simultaneous suppression and activation without external help**
The Marshmallow Task-- Delay of Gratification	Children are presented with a marshmallow and told that if they wait to eat the marshmallow until the experimenter returns, they will receive a larger amount of the treat (2 marshmallows instead of 1).	*Option A:* Eat the marshmallow immediately and forfeit the opportunity to receive two	*Option B:* Wait to eat the marshmallow until the experimenter returns to get two marshmallows	Exogenously- The researcher imposes the abstract rule of eat now and only receive one treat, or wait and receive two.	*Only if*— The participants (a) have the desire to immediately eat the marshmallow and (b) want two marshmallows	Yes
Grass/Snow	Children are asked to point to the white card when the experimenter says grass, and the green card when the experimenter says snow.	*Option A:* Point to the color congruent with the object verbalized by E (e.g., white/snow)	*Option B:* Point to the color incongruent with the object verbalized by E (e.g., white/grass)	Exogenously—The researcher imposes the abstract rule of point to the color opposite of the object verbalized	*Only if*— The participants (a) have a prepotency to point to the color congruent with the object verbalized and (b) have the desire to follow directions and execute the behavior opposite of the prepotency.	Yes
Dimensional Change Card Sort	Children are first asked to sort cards by shape (rabbit/boat) and then instructed to sort the cards by color (blue/red)	*Option A:* Sort in accordance with the initial action tendency (by shape)	*Option B:* Sort by the characteristic opposite of that used in previous trials (by color)	Exogenously—The researcher imposes the abstract rule of sort by color	*Only if*— The participants (a) have a prepotency/conditions action tendency to sort by shape and (b) have the desire to follow directions and execute the behavior opposite of the prepotency.	Yes
Head-to-Toes	Children are asked to play a game in which they are instructed to perform an action opposite of the experimenter's verbal commands (i.e. touch their toes when instructed to touch their head, and vice versa).	*Option A:* Perform action opposite of verbal command	*Option B:* Perform action congruent with verbal commands	Exogenously- The researcher directs the child to follow the abstract rule of doing the opposite of what he or she indicates verbally	*Only if*— The participants (a) have a strong tendency to execute behaviors congruent with verbal command and (b) have the desire to follow directions and execute the behavior opposite of the prepotency.	Yes

Table 3

The Pour Task Protocol

Trial	Pour #	Water poured (oz.)	Empty cup (oz.)	Person Pouring	Experimenter present (Y/N)	Reward Received (Y/N)	Purpose of trial
Assessment of Spill Avoidance	1	6	5	Child	Y	N	Assess if the child has an internalized desire to avoid spilling over. Establishes a behavioral baseline used to validate the presence of regulation during test trials
	2	6	5	Experimenter	Y	N	
	3	8	7	Child	Y	N	
	4	8	7	Experimenter	Y	N	
	5	**8**	**3**	Child	N	N	
Empty-Reward Association	6	2	3	Experimenter	Y	Y	Build an association between pouring all of the liquid out and receiving a reward; develop an action tendency.
	7	2	3	Child	Y	Y	
	8	2	3	Experimenter	Y	N (White)	
	9	8	10	Child	N	Y	
	10	8	10	Experimenter	Y	Y	
Endogenously Triggered Regulation	11	**8**	**3**	Child	N	N (White; no reward even if child spills over)	Assess regulatory competency when an internalized standard and action tendency conflict without researcher given directives.
----------	12	3	5	Experimenter	Y	Y	Maintain/renew interest in reward; continue turn taking
Exogenously Triggered Regulation	13	8	10	Child	Y	N (White; no reward even if child does not stop when directed)	Assess regulatory competency when a conditioned action tendency and researcher created rule come into direct conflict.

Table 4

Dichotomously Coded Variables

Variable Name	Variable Description	Variable Coding
Color Identification	Ability to verbally label all 6 colors	Children who can identify all 6 colors will be coded as 1. Children who can identify five or fewer colors will be coded as 0.
Card Sort	Demonstrated understanding of color/prize association	Children who can verbally or otherwise behaviorally indicate an understanding of the association will be coded as 1. Children who in no way demonstrate an understanding of the association will be coded as 0.
Compliance	Compliance to researcher instruction to clean-up	Children who comply with researcher directives will be coded as 1. Children who do not comply with directives will be coded as 0.
Presence of Conflict	Behavioral differences between baseline and test trials	The presence of observable behavioral differences from baseline (Spill Avoidance) to test trials will be coded as 1. No observable difference in behaviors from baseline to test trials will be coded as 0.
Internalized Spill Avoidance	Demonstrated avoidance of spilling over	Children who do not spill over on any of the pours in this trial, and who do not allow the experimenter to spill over on any pours, will be coded as 1. Children who spill over on one or more, or who let the experimenter spill over on one or more pours, will be coded as 0.
Endogenously Triggered Regulation	Spilling over during the test trial	Children who do not spill over on Pour 11 will be coded as 1. Children who spill over on Pour 11 will be coded as 0.
Exogenously Triggered Regulation	Ceasing to pour when directed to do so	Children who stop pouring immediately when directed to do so and who do not initiate subsequent pouring after the command will be coded as 1. Children who do not stop pouring immediately when directed to do so or who stop but re-initiate pouring will be coded as 0.
Delay of Gratification	Ability to delay eating the marshmallow two minutes until the researcher returns.	Children who do not eat the marshmallow until the researcher returns to the room after the delay will be coded as 1. Children who do eat some or all of the marshmallow while the researcher is absent during the delay will be coded as 0.

Figure 1
Assessment Room

Assessment Room Diagram

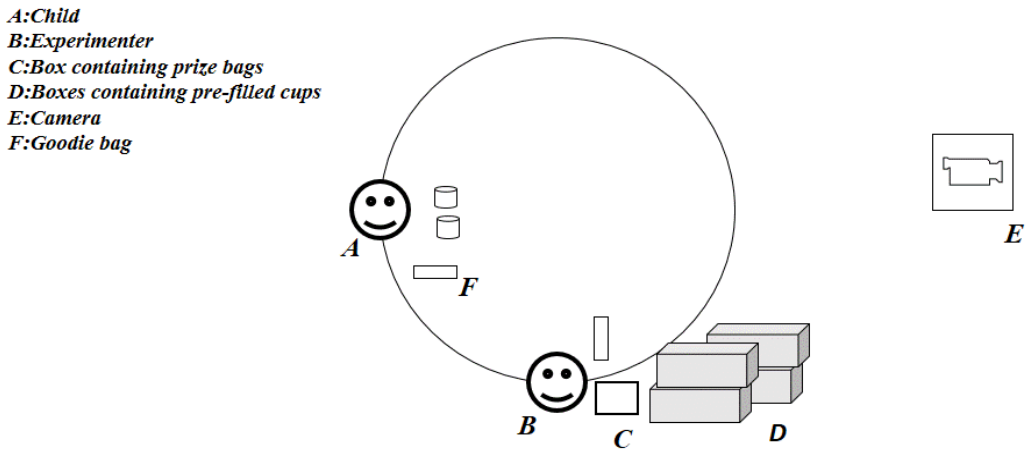

Figure 2

Endogenously Triggered Self-Regulation Test Trial

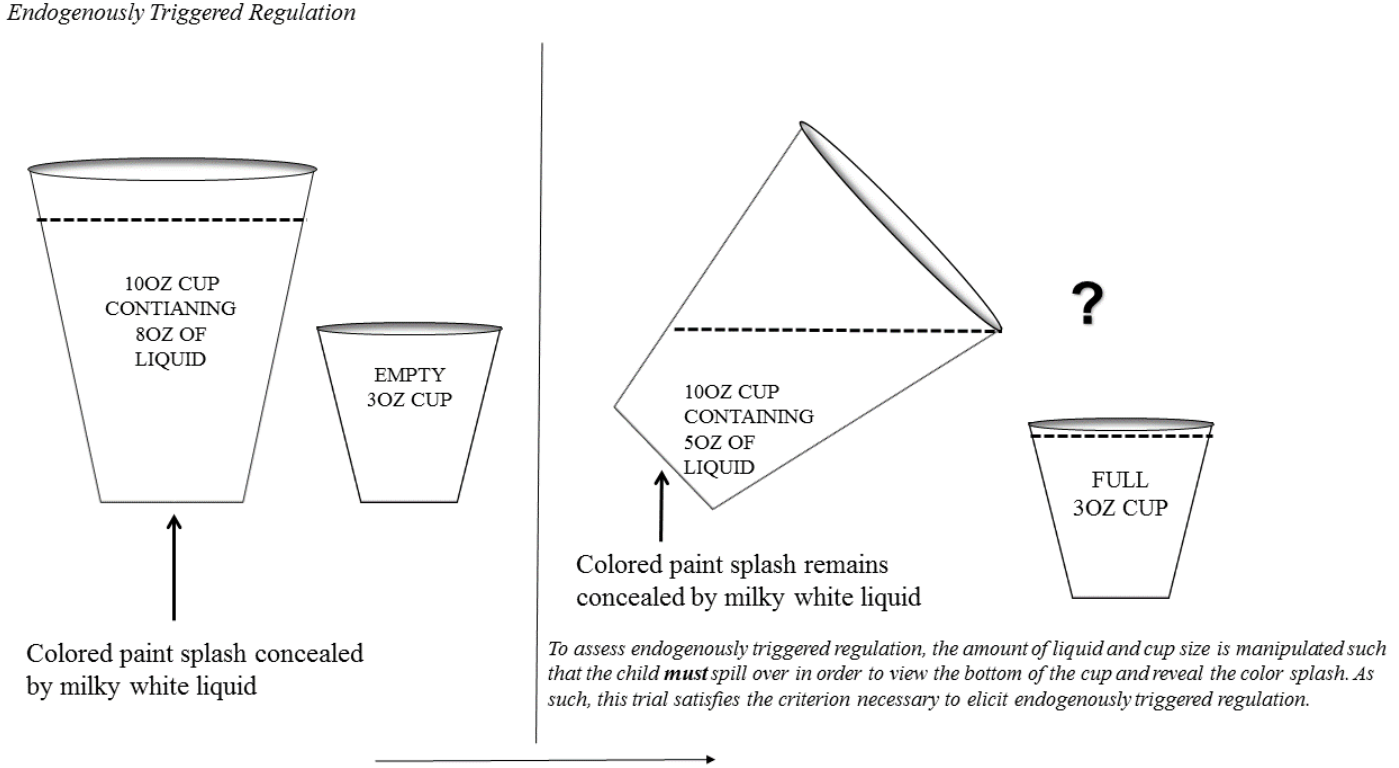

Figure 3
Exogenously Triggered Self-Regulation Test Trial