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CONTRIBUTIONS OF NEGATIVE EMOTIONS AND PRIVATE SPEECH TO 48-MONTH-OLDS' TASK PERSISTENCE

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ABSTRACT

The thesis investigated the contributions of 48-month-olds' negative emotion expressions and private speech utterances to task persistence. It was hypothesized that anger would predict greater persistence whereas sadness would predict less persistence, and that task-referencing private speech would predict greater persistence, whereas self-referencing or other forms would predict less persistence. Measures were derived from a laboratory observation eliciting children's negative emotion, the Transparent Locked Box procedure (Goldsmith et al., 1995). Further, the thesis examined these questions using two methodological approaches, ANOVA models which collapsed across time, and a process-oriented approach, survival analysis. Relations were examined controlling for child gender and verbal intelligence. Results were somewhat consistent with hypotheses and revealed that anger predicted greater persistence, but sadness and private speech utterances were not associated with persistence. Further, an interaction between sad expressions and task-referencing statements emerged in ANOVA models, while an interaction between angry expressions and self-referencing private speech emerged for survival analysis. Interpretation of these findings was discussed.

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Chapter 1. INTRODUCTION

Self-regulation, broadly defined as the process of purposefully modulating one's behaviors in order to meet a situational demand or goal (Carver & Scheier, 2011), has been identified as an important component of children's school readiness (McClelland, Acock, & Morrison, 2006) and school success (Duckworth & Carlson, 2013). Amongst many other academic skills, self-regulation is fundamental for a child's ability to stay engaged in cognitively- and emotionally-taxing academic tasks rather than give up (Fredricks, Blumenfeld, & Paris, 2004). Increasingly, both basic and applied scientists have emphasized the importance of conceptualizing self-regulation as a dynamic process, involving the flow and interplay of children's emotions, thoughts, and actions, rather than a characteristic of the individual (Carver & Scheier, 1998; Zimmerman & Schunk, 1989). Moreover, evidence drawn from investigations of dynamic self-regulation has the potential to explain conditions that support or undermine children's learning, allowing researchers to better refine and develop interventions (e.g., Linnenbrink, 2006).

The preschool years are a key developmental period for self-regulation, as children transition from relying solely on adult external regulation to modulate their emotions and behavior, and begin to have the ability to rely on themselves (Kopp, 1982, 1989). These strides in the development of self-regulation are thought to be mediated by children's growing cognitive abilities, in particular language, and developing capacity for emotion regulation (i.e., modulation of emotional responses). Cognitive capacities such as the ability to understand and use language are thought to be essential for young children's ability to monitor their own behavior and emotion and to engage in strategies that help them tolerate disappointments and frustrations (Kopp, 1982). For example, although infants might express their sadness by crying, which

evokes support from others, young preschool-age children have the option of engaging their language abilities to reflect upon, reason about, and communicate needs (Cole, Pemberton, & Armstrong, 2010). In the classroom context, 84% of kindergarten teachers surveyed by the National Center for Education Statistics expressed that it is important for children to verbally articulate their wants, needs, and thoughts before they enter kindergarten (Blair, 2002). Although these teachers focus on children's communicative speech, Vygotsky (1934/1962) theorized that overt private speech (i.e. the act of talking aloud without the intention of another person hearing or responding) is an important way that language helps children monitor their behavior and engage in better problem-solving. Private speech is a specific expressive language skill that emerges during the preschool years and has the potential benefit of helping children learn new, intellectually challenging skills.

Emotional competence is one key component of self-regulation and school readiness (e.g., Blair, 2002; Thompson, Lewis, & Calkins, 2008). In the academic context, parent reports of children's emotion regulation skills predict teacher reports of kindergartners' academic success, even after controlling for child IQ (Graziano, Reavis, Keane, & Calkins, 2007). Emotion regulation, conceptualized here as an aspect of the broader construct of self-regulation, is complex. In the literature focused on its development, the emphasis is usually the need for children's emotions to be regulated, because strong emotion is often associated with disruptive behavior (Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996). However, a dynamic view of the self-regulation of emotion must recognize the functional consequences of emotion and their role as regulatory. That is, emotions organize behavior by influencing psychological processes such as attention, reasoning, and action (Cole, Martin & Dennis, 2004), and have implications for an individual's physiology, thoughts, and decision-making relevant to learning (Campos, Frankel, &

Camras, 2004; Immordino-Yang & Damasio, 2007). To illustrate emotion as both regulating and a regulator, imagine a preschooler becoming frustrated while trying to complete a difficult puzzle. The child's frustration can motivate increased determination and effort and the generation of alternative problem-solving tactics, but the frustration also has the potential to derail these problem-solving efforts and lead a child to toss the puzzle aside and cry. Frustration that is modulated can organize persistence despite obstacles in the task, but frustration that is less modulated may lead to further distress and failure to persist. It is only in recent years that emotion as a regulator of behavior, and not just a phenomenon to be regulated, has been considered in educational research. Recently, this more dynamic view of emotion regulation has been identified as a key area to study to understand children's academic motivation (Blair, 2002; Meyer & Turner, 2006).

In addition to the influences of language and emotion on self-regulation, there is acknowledgement that language and emotion can influence each other in meaningful ways (Cole et al., 2010; Kopp, 1989; Thompson, Lewis, & Calkins, 2008). An intervention integrating language and emotion, the Head Start REDI intervention, found that targeting four-year-olds' social-emotional competence and language/literacy skills resulted in gains in school readiness skills and behaviors one year later (Bierman et al., 2008) and as they ended kindergarten (Nix, Bierman, Domitrovich, & Gill, 2013). Further, improvements in social-emotional competence skills uniquely predicted reading achievement at the end of kindergarten, providing evidence of cross-domain influences (Nix et al., 2013). Most research on children's speech has focused on cognitive aspects of motivation and success and not on emotional processes; however, verbalizations such as private speech may also have cross-domain influences, facilitating

children's self-management of difficult emotions and their ability to engage in self-regulated learning (Schunk, 1986).

As such, this thesis aims to empirically investigate the independent and combined influences of emotion and language on young children's self-regulation, examining the degree to which their nonverbal emotion expressions and use of private speech independently and in tandem relate to their persistence over the course of a difficult task. Using a frustration-eliciting task from a battery of observational procedures designed to assess children's negative affectivity (Transparent Locked Box procedure; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995), this thesis will use two methodological approaches to test predictions that 48-month-old children's nonverbal negative emotion expressions, overt private speech utterances, and their interaction, explain their task persistence. First, a traditional approach that collapses across time will examine how these factors contribute to proportion of time children persist across the task. Second, survival analysis (Kleinsmith & Klein, 1996) will capitalize on time-series information to examine how these factors influence the probability of an event, children's task cessation.

Private speech and self-regulation

Overt private speech involves the use of self-directed verbalizations and is theorized to help a person self-monitor and organize thoughts, feelings, and behaviors (Vygotsky, 1934/1962). Based on his observations with children, Vygotsky (1934/1962) also found that private speech facilitated a transition from a predominant use of speech to communicate with others (social speech) to the central use of speech to organize thought (internalized speech). Notably, the developmental transitions from social speech to private speech to verbally-mediated thinking parallel Kopp's (1982, 1989) description of a developmental shift in children's self-regulation: from relying on others to regulate their emotions and actions (external regulation) to

their autonomous ability to regulate emotion and action (self-regulation). Several empirical studies have documented a transition from social speech to private speech (e.g., Berk & Garvin, 1984; Kohlberg, Yaeger, & Hjertholm, 1968), as well as from overt private speech to partially internalized, or covert private speech (e.g., Kohlberg et al., 1968; Winsler, Diaz, & Montero, 1997; Winsler & Naglieri, 2003). During early childhood, children's overt private speech during successful item responses followed an inverted quadratic function, peaking at three and a half years, while covert private speech, operationalized by inaudible utterances and silence, peaked at ages three and five years (Winsler et al., 1997). After age five, private speech is less prevalent, but still used throughout the lifespan, particularly when individuals encounter a cognitive challenge (Winsler, 2009).

Private speech during cognitively-taxing tasks plays an important role in children's development of self-regulation and their task performance (Berk, 1999; Zivin, 1979). Elementary school children's trajectory of overt to covert private speech was positively related to their attention and task-facilitating nonverbal behavior while completing math assignments in the classroom (Bivens & Berk, 1990). Further, in an intervention study, training impulsive children to use self-instructional private speech improved their attentional and behavioral strategies during a cognitive task (Meichenbaum & Goodman, 1971). Generally, private speech has had a linear relation to task performance in adults and children (Fernyhough & Fradley, 2005), indicating that it may not only assist children and adults in managing their internal states and behaviors, but that it may also be useful tool for successful academic performance. Despite this evidence, it is notable that elementary school students reported that private speech had mixed effects in terms of its helpfulness for solving difficult math problems (Rohrkemper & Bershon, 1984). Further, longitudinal work reveals that private speech use in first grade related more

strongly to task performance one year later than concurrent task performance (Bivens et al., 1990). Moreover, evidence has revealed differences in frequencies of children's private speech use based on task characteristics (Frauenglass & Diaz, 1985).

Although the exact mechanism by which private speech relates to self-regulation is unknown, it has been suggested that private speech may motivate a child to persist during learning challenges (Atencio, 2004; Asarnow & Meichenbaum, 1979). In support of this view, mastery-oriented learning behavior, i.e. persistence of engagement in a task without the help of an adult, was associated with greater use of private speech (Chiu & Alexander, 2000). However, an inverted U-function described the association between young adults' (Duncan & Cheyne, 2002) and five- and six-year-old children's (Fernyhough et al., 2005) private speech and task difficulty. Thus, private speech may be most useful for successful outcomes during tasks that are challenging and require motivation for persistence, but that are not beyond an individual's ability.

Another function of private speech, both overt and covert, may be its ability to help children convert experiences into conscious thoughts, i.e. mental objects that can be manipulated (Cole et al., 2010). This idea is similar to the concept of psychological distancing that refers to adults' ability to verbally reflect upon their experiences, thereby creating distance from the immediate emotional experience and instead adopting a verbally-mediated appraisal of the situation (Ayduk & Kross, 2010; Kross & Ayduk, 2011). Although this construct is infrequently applied to research with children, evidence suggests that children's symbolic representations of experience can enhance their self-control. Viewing symbolic representations, as opposed to actual objects, enhanced three-year-old children's executive control, suggesting that symbolic representations may allow psychological distancing that increases children's ability to exert control over their thoughts and actions (Carlson, Davis, & Leach, 2005). Language is a common

symbolic representation and may function similarly, allowing children to reflect upon and reason about their ongoing experience in order to self-regulate.

Verbal intelligence versus language use. Importantly, the current study will focus on language use, i.e. private speech, rather than children's verbal intelligence. Verbal intelligence reflects a child's knowledge of language-related rules, whereas language use reflects the application of those rules in the context of social interactions, emotions, and other factors (Widdowson, 1989). The distinction between verbal intelligence and language use is important as a child could effectively use language, but be limited in what knowledge he or she has. However, the converse is also possible; a child could have knowledge of language or linguistic principles that cannot be accessed when needed (Chomsky, 2005; Widdowson, 1989).

Evidence suggests relations between verbal ability and self-regulation. For example, children who have language delays display more behavior problems that involve poor self-regulation than do their language-typical peers (Baker & Cantwell, 1992). In typically developing children, evidence is more limited; however, higher scores on preschoolers' language tests were related to greater use of distraction strategies in a clean-up task with their mothers, suggesting more successful self-regulation in this context (Stansbury & Zimmerman, 1999). Further, verbal ability as indexed by children's vocabulary predicts later behavior problems over and above demographic factors such as socioeconomic status and other academic or intelligence measures, such as reading comprehension (Peterson et al., 2013).

Despite theory that asserts the importance of language skills for the development of effective self-regulation, empirical studies of the direct effects of children's language use on aspects of their capacity to self-regulate are sparse (Cole et al., 2010). Initial evidence does indicate that language use, specifically speech, is related to persistence during a challenge and

broader self-regulation. In their influential work on learning responses, Diener and Dweck (1978) found differences in children's speech content between two patterns of behavior that children exhibit during learning challenges. Children using a helpless response pattern generally withdrew from challenges, whereas children using a master-oriented response pattern persisted through challenges. Speech content differences emerged between the two groups after they experienced failure. Helpless children used more ineffectual task-strategies, attribution, and negative affect statements. Mastery-oriented children, in contrast, used more self-instruction, self-monitoring, and positive affect statements. Although this difference in how children used their speech was not the primary aim of this work, it is of note that speech of a particular content was associated with the more persistent learning pattern. Indeed, it is theorized that the content of children's speech is important to understanding its relation to self-regulation (Schunk, 1986).

In addition, evidence supports that language use contributes to self-regulation over and above general cognitive ability. At age 36 months, children's spoken vocabulary predicted parent-rated self-regulatory skills even after controlling for parent reports of children's cognitive ability (Vallotton & Ayoub, 2011). Similarly, in this thesis, verbal intelligence will be used in models with private speech as a significant predictor. This method will allow the thesis to examine whether children's private speech relates to nonverbal emotion expressions and task persistence over and above contributions of verbal intelligence.

Nonverbal emotion expressions and self-regulation

In the context of learning, emotions surely play a role in how children cope with challenges and persist at a task. Surprisingly, the exact nature of the role of emotion in this regard is not well-understood. One view is that when individuals believe that they are not making sufficient progress toward their learning goal, they experience goal-incongruent emotions, such

as anger or anxiety, and that these emotions influence self-regulatory behaviors (Schutz & Davis, 2000). In support of this view, children who report more anger and anxiety in regard to school activities such as taking exams also reported having less academic motivation, using fewer metacognitive learning strategies, and relying more on external regulation, i.e. guidance from others instead of themselves (Pekrun, Goetz, Titz, & Perry, 2010). On the other hand, several studies support a positive relation between anger, in particular, and self-regulation. When desired goals were blocked, anger increased motivation to persist at a frustrating task in both adults (Lench & Levine, 2008) and young children (He, Xu, & Degnan, 2011). Further, three-year-old children's low-level anger expression in one second was most likely to be followed by task persistence in the following second (Perri, 2010). Finally, in a study of three- and four-year-olds whose desired goal was blocked, anger was associated with the largest range of adaptive coping behaviors (Dennis et al., 2010). Together, these findings support the notion that emotions, in particular anger, are related to self-regulatory behavior such as task persistence; however, it is unclear whether emotion promotes successful or unsuccessful behaviors.

In order to understand divergent findings on the role of negative emotion in self-regulated behavior, it may be essential to examine how hypothesized emotion functions promote successful versus unsuccessful behaviors for a particular context. Among adults, anger and joy are regarded as indices of motivation to approach a goal, whereas sadness and fear are thought to index withdrawal from a goal (Adams, Ambady, Macrae, & Kleck, 2006; Carver & Harmon-Jones, 2009). In the current thesis, the context of being left alone with the challenge of opening a box to get a selected toy challenges children's ability to persist at the task without becoming overwhelmed by negative emotion, parallel to the type of behavior that is expected when children reach school age (Fredericks et al., 2004). Approach motivation emotion such as anger

may be useful in this context, whereas a withdrawal motivation emotion such as sadness may hinder the child's persistence.

The interplay of private speech and emotion

Evidence from the private speech literature underlines the importance of emotion in the context of task persistence. Seventy-four percent of four-year-old children's private speech during a finger maze task was classified as task irrelevant speech or vocalizations, and the content of these utterances was typically verbal expressions of emotion in response to errors (Zivin, 1972). Moreover, extant work on nonverbal emotion has produced mixed results concerning whether private speech is helpful or harmful in the context of negative emotions. In a dissertation study, children rated by parents and teachers as having better emotion regulation skills used more private speech than children rated as having worse skills (Broderick, 2001). In contrast, an empirical study found that children screened for having behavioral problems engaged in more private speech than their peers (Winsler, Diaz, Atencio, McCarthy, & Chabay, 2000) but were similar to their peers in task performance (Winsler, Manfra, & Diaz, 2007). As children with behavior problems are thought to be less emotionally well-regulated than their peers (Cole et al., 1996), it is possible that private speech helps children who typically struggle with self-regulation of emotion and behavior.

The evidence addressing the influence of private speech on emotion and its regulation in tasks that challenge children's goals is limited. To our knowledge, only one study has observed both children's private speech and their emotion expressions rather than relying on parent- or teacher-reported ratings of children's emotional competence. Using the same procedure as this thesis, young children's "facilitative task-relevant" private speech (e.g., Does that fit?) was associated with lower ratings of average anger intensity, while "negative task-relevant" private

speech (e.g., I can't do this) was associated with greater ratings of average anger and sadness intensity (Day & Smith, 2013). These findings support the notion that types of speech and emotion function differently in terms of task-relevance. Notably, the distinctions made in classifying children's private speech in Day and Smith (2013)'s study focus on content but also assume function. That is, it is assumed, based on prior research that saying "I can't do it" is negative task-relevant. However, preliminary observations of the data in this thesis indicated that this utterance can also be followed by task persistence. Therefore this thesis examines the relations between children's private speech, including different types of speech, and their task persistence. Specifically, the function of content-based speech categories will be tested empirically, establishing how facilitative or perhaps intrusive they are for children's task persistence and whether this depends upon children's emotions during the task.

Another key point of Day and Smith (2013)'s study is that facilitative private speech was associated with lower ratings of average anger intensity. As facilitative private speech would be expected to be associated with better self-regulation, this finding contributes to the perplexing literature on the role of anger in self-regulation. As discussed, anger has also been found to be related to (He et al., 2011) and to precede (Perri, 2010) efforts to persist; thus, this study emphasizes the need for work that can elucidate the role of negative emotion, particularly anger, in self-regulation.

Together, research on the interplay of negative emotion and private speech is limited, but suggests that emotion and speech are related in complex ways. This thesis aims to shed light on this relation by examining different types of speech content and negative emotion. Further, this thesis will be the first to examine interactions between private speech and observed negative emotion in the service of a self-regulatory goal.

Current study

The current thesis examined the contributions of overt private speech utterances and nonverbal negative emotional expressions to children's task persistence at 48 months. As a whole, previous work on private speech and emotion uses methodology that collapses across time. However, losing time-varying aspects of study variables may not be ideal for understanding the dynamics of self-regulatory processes. Capturing the "when" of task persistence may be particularly important, as time-limited goal disengagement is considered adaptive for individuals (Wrosch, Scheier, Carver, & Schulz, 2003). For example, in the classroom, a student who engages in distraction temporarily but then returns to complete a challenging assignment would be considered more successful than a child who persists early on but ultimately gives up on the assignment. In approaches that collapse across time, this potentially meaningful qualitative difference would not be captured. Thus, in this thesis, two methodological approaches were considered.

First, the traditional approach of collapsing across time was used to predict the proportion of time children persisted. Second, in survival analysis the cessation of task persistence served as the dependent variable, as it captures the event of giving up in the face of a challenge, a common learning obstacle for many children. As an advantage of survival analysis is that only *prior* predictors of task cessation are examined, allowing for more directional conclusions, it was also expected that survival analysis would allow for greater precision of results. It was hypothesized that the presence of negative emotions would predict greater task persistence. In particular, anger would predict greater task persistence whereas sadness would predict less task persistence. Further, it was hypothesized that the presence of private speech would predict greater task persistence. In particular, based on mechanisms proposed by Vygotsky (1934/1962), task statements would predict greater task persistence. However, based on Carlson (2005), it may be

that content of private speech does not influence task persistence, as any private speech may provide psychological distancing. Finally, an exploratory aim of this thesis was to examine the degree to which private speech use would moderate the association between negative emotion expressions and task persistence. It was hypothesized that engaging in task-referencing statements in the presence of anger would be particularly advantageous for task persistence. Using task statements that may reflect problem-solving could allow children to capitalize on approach motivation. In contrast, engaging self-referencing statements in the presence of sadness might be worse for children's task persistence, as they may be less motivated to engage in the task and the statements may be distracting.

Chapter 2. METHOD

Participants

Data for the thesis project was collected as part of a larger longitudinal study of emotion regulation capacities in toddlers and preschoolers (Development of Toddlers Study; Cole, Crnic, Nelson, & Blair, 2000). Children were assessed in the lab when they were 18, 24, 36, and 48 months old and in their homes when they were 18, 30, 36, and 48 months old. Retention rate from the initial 18 month data collection to the 48 month age data collection was 96.8%. The study sample at the 42 month data collection did not differ from the sample at the 18 month data collection on maternal education level, $t(122) = -1.27$, $p = .21$, and paternal education level, $t(120) = -1.47$, $p = .15$. The samples did, however, differ on household income, $t(118) = 5.27$, $p < .001$. Families had lower household incomes on average at the 18 month data collection (M = \$42,135.83, SD = \$15,986.36) than the 42 month data collection (M = \$49,470.25, SD = \$21, 917.40).

For the thesis, analyses focused on the Transparent Locked Box task (see description in Procedure), which was conducted during the lab visit at child age 48 months. A total of 120 children (54% male) completed the Transparent Locked Box procedure at 48 months (M = 48.33, SD = .67). Mother-reported race for children was 93.3% White and 6.7% Biracial at the 48 month data collection. All families were from rural and semirural areas and, at the 42 month data collection, had average parent-reported household income levels of $49,016.47 ($SD$ = $22,377.01).

Procedure

After mothers and their 48-month-olds adjusted to their visit to the lab, mothers and children separated to engage in different activities in the experiment room. Mothers completed an interview with one research assistant while children engaged in a variety of laboratory tasks, which alternated between those designed to elicit frustration and those that children typically enjoy and which were chosen to provide relief from the frustration tasks (e.g., free play, snack time). All child procedures were video-recorded for subsequent transcription and/or coding.

The Transparent Box procedure (Goldsmith et al., 1995) was the fifth procedure completed in the 48 month lab visit. This procedure was designed to elicit frustration or anger in young children, as the child is unable to get a selected toy that they are allowed to take home. In other studies, this procedure has been successful at eliciting anger in young children (Buss & Kiel, 2004; Dennis, 2010; Jahromi & Stifter, 2008).

In the study from which the thesis data will be drawn, the research assistant invited the child to select a toy to take home from a selection of three small toys: Diecast cars, Care Bears, or Block Buddies. The research assistant then placed the child's preferred toy in a large clear acrylic box, locked the box, and then taught the child to open the box with a key. Once the child

could unlock the box independently, the research assistant indicated that s/he needed to do some work in another room, would return soon, but in the meanwhile the child could open the box and get the gift to take home. The research assistant then handed the child the set of keys but unbeknownst to the child, this set of identical keys did not fit the lock on the box. As the research assistant left the room, s/he said to the child, "*I'll be back in a little bit. I will let you work on that for a while. When you open the box, you can play with the toy inside!*" After 3 minutes, the research assistant opened the door to the playroom, noticed the box was not open, and instructed the child to keep trying and that s/he would return in a few minutes. After another 2 minutes, the research assistant returned. The research assistant then asked the child about his/her emotions and thoughts about trying to open the box. Next, the research assistant acknowledged a mistake, that the keys were the wrong keys, and gave the child the correct keys. Finally, the child opened the box and retrieved the preferred gift, which the child was able to take home.

Measures

The target variables for analysis were taken from three independent coding systems applied to classification of children's behavior during the Transparent Box procedure. The variables were taken from the coding of children's private speech utterances, emotional expressions, and behavior during the task. Each of these three categories was coded from video records by independent coding teams, unaware of the work of the other teams. In each coding team, data were coded in one-second intervals and the data files were time-synchronized by having each team start coding at identical start times. Coders in each team were trained to 90% accuracy with a master coder for their specific coding system, and inter-rater reliability was

conducted throughout the coding by having 15% of the cases double-coded by individuals unaware that the cases were reliability cases.

Private Speech Utterances. Speech utterances were transcribed verbatim by trained research assistants. An utterance was defined by a t-unit, i.e., the main clause and its subordinate clauses (Hunt, 1965). Transcribers also recorded the direction of the speech (i.e., to whom the child was speaking); approximately 76.6% of utterances were private speech and 23.4% were directed at the experimenter (e.g., child asking for help when the experimenter interrupts at 3 minutes).

The private speech content coding scheme categorized speech first based on reference (self, task, other/ambiguous) and then based on valence for self- and task-references (positive, negative, other). Other/ambiguous categories were subdivided into references to another person and ambiguous references. Each speech category and examples are provided in Table 1. Inter-rater reliability for the frequency of private speech content categories was ranged from Kappa = .51 to .75 ($p < .001$). Models will use presence (1) or absence (0) of overall private speech utterances and of each private speech content category.

Table 1

Examples of Private Speech Content Codes

Private Speech Content Code		Example
Self-reference	Positive	I think I can get it.
	Negative	I can't do it.
	Ambiguous	I want xx.
Task-reference	Positive	Put the key in.
	Negative	It can't fit.
	Ambiguous	The key.
Other/Ambiguous reference	To Other	Mommy.
	Ambiguous	Whoa; Just xx xx

Note. Examples provided are from transcripts.

Nonverbal Negative Emotion Expressions. Sad and angry emotional nonverbal expressions were coded from video-recordings for the entire task. Emotion expressions were defined by facial, prosodic, and other nonverbal cues such as gestures and posture (Cole et al., 1994). For seconds that children were out of the camera frame or turned away from the camera, missing values were recorded unless there was vocal data. Inter-rater reliability for the frequency of emotion expressions was Kappa = .85 ($p < .001$). A negative emotion composite (anger and sadness) as well as differentiated approach (anger) and withdrawal (sadness) motivation categories was used. Models used presence (1) or absence (0) of nonverbal negative emotion expressions and each discrete emotion.

Task Persistence. The Transparent Box procedure is an analogue task for persisting at a difficult task despite a blocked goal, getting the selected toy. Thus, persisting at trying to open the box in appropriate ways is the behavioral outcome of interest. Task persistence did not include behavior that was destructive, e.g., trying to break the box open. The behavioral coding system included two codes that were used to construct a task persistence variable. Specifically, attempts to open the box with the keys and alternative attempts to open the box (e.g., trying to see if the lid could be pried open, trying to open at the hinges) were used to define task persistence. Thus, task persistence was coded as present (1) when the child made appropriate efforts with the keys or without them, and coded as absent (0) when the child engaged in any other behavior.

In ANOVA models, task persistence was defined by proportion of total task time persisting. In survival models, task persistence was defined by seconds until the target event of task cessation (Table 2). To measure when a child ceased to persist, task cessation was defined

by the second when the absence of task persistence (0) was followed by no subsequent instances of task persistence.

Table 2

Example of Cessation of Task Persistence in an Eight-second Task

	Second in Task							
Variable	1	2	3	4	5	6	7	8
Task Persistence	1	1	0	0	1	0	0	0
Cessation of Task Persistence	-	-	-	-	-	X	-	-

Note. Task persistence= 1 if present, 0 if absent; Cessation of task persistence= X

Verbal Intelligence. The Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III; Weschsler, 2002) was the fourth procedure administered to 48-month-old children at the lab. During this task, experimenters administered the seven core subtests to children in a quiet room. Subtests that comprise the Verbal Intelligence Quotient (VIQ) will be used to control for verbal intelligence in this thesis. The three subtests in the VIQ are Information, in which the child answers general knowledge questions, Vocabulary, in which the child provides the definition for a word, and Word Reasoning, in which the child identifies an object or concept after a series of verbal prompts. Standard scores were used for the composite; thus, average VIQ scores are in the range of 80 to 120. The WPPSI-III VIQ will be used to control for children's verbal intelligence after simpler models are conducted.

Data Analytic Overview

All models were conducted with child VIQ and child gender entered as covariates in order to determine whether children's language use predicts task persistence over and above their verbal intelligence and gender. First, ANOVA models were conducted to examine associations between negative emotions and private speech, collapsing across time. Next, parallel survival models were conducted to examine associations between negative emotions and private speech, accounting for children's individual time series. Models are described in further detail below.

Conventional Approach: ANOVA Models. The first set of models examined the overall and specific contributions of nonverbal negative emotion expressions and overt private speech to task persistence. An initial model was conducted to examine the extent to which the presence of private speech, the presence or absence of nonverbal negative emotion expressions, and their interaction was associated with the proportion of time children persisted during the task. Then, another model was conducted to examine the extent to which the presence of self, task, and other statements, the presence or absence of angry and sad expressions, and their interaction was associated with proportion of time persisting. Finally, if any significant speech reference results emerged, a model considering valence of speech reference was conducted.

Dynamic Approach: Survival Models. In order to address the limitations in the literature regarding studying self-regulatory processes, the second set of models were analyzed using a time to event approach, referred to as survival analysis (Kleinbaum & Klein, 1996; see Landau, 2002 for applications in social sciences; Wright, 2000). Specifically, the semi-parametric form of survival analysis, referred to as the Cox regression (Cox, 1972), was used to examine the contributions of private speech, negative emotion expressions, and their interaction to task cessation. The basic formula of this proportional hazards model is as follows, where $h_0(t)$ is the baseline hazard function, β is an unknown parameter, and *x* is the covariate:

$$h(t) = h_0(t)e^{\beta_1 x_1 + \ldots + \beta_k x_k}$$

In this statistical procedure, the dependent variable is a hazard ratio or probability, indicating the extent to which a predictor variable increases or reduces the probability of the target event, the cessation of task persistence. Because the dependent variable is a probability, its inverse represents the probability that task persistence occurs. Positive relations would indicate that the predictor variable increased the likelihood of task cessation; in other words, reduced the probability of task persistence. Negative relations would indicate that the predictor variable decreased the likelihood of task cessation; in other words, increased the probability of task persistence.

First, this model examined the extent to which the presence of overall private speech moderated the association between the presence of nonverbal negative emotion expressions and seconds until task cessation. Then, another model was conducted allowed for greater specificity in terms of presence of different speech contents and of discrete emotions. Finally, if any significant speech reference results emerged, a model considering valence of speech reference was conducted.

Chapter 3. RESULTS

Descriptive Statistics

The following descriptive statistics for predictors include child emotion expressions and private speech variables for the duration of the entire Transparent Locked Box task, which were entered into ANOVA models. Each individual's time series was truncated to his or her survival time before being entered into survival models.

Negative emotion. Of the 107 children, the majority (86.0%) displayed negative emotion during the task. The primary negative emotions displayed were anger and sadness, and children

could display either or both of these emotions. Most children expressed anger (75.8%), while only 29.7% expressed sadness.

Private speech use. Of the 107 children, most (63.6%) engaged in private speech during the task. Note that it was possible for children to use more than one category of private speech during the task and that use of any category was associated with use of the other categories, all χ^2 s (1, N =107) > 20.570, ps < .001. Of those who used private speech, 63.2% used self-statements, 64.7% used task statements, and 80.8% used ambiguous/other statements.

Of self-statements, approximately 13.7% were positive valence, 73.6% were negative valence, and 12.7% were ambiguous. Of task statements, 23.6% were positive, 25.3% were negative, and 51.1% were ambiguous. Of ambiguous or other statements, 21.8% were reference to another person, and 79.2% were ambiguous references (e.g, *Just xx xx* or *Whoa*).

Chi-square associations. The associations between children's negative emotion expressions and private speech use categories were examined using χ^2 tests. Counts per cell are summarized in Table 3a (reference) and 3b (valence). There was a significant association between negative emotion and private speech, χ^2 (1, N =107) = 5.55, p < .05. Specifically, there were significant associations between anger and self-statements, χ^2 (1, N =107) = 7.611, p = .007, and between anger and task statements, χ^2 (1, N =107) = 8.050, p = .004. Anger was not associated with other statements, χ^2 (1, N =107) = 2.828, p = .122. When considering valences, negative self-statements was associated with anger, χ^2 (1, N =107) = 7.196, p = .008, and references to another person was associated with anger χ^2 (1, N =107) = 11.890, p = .001. All other speech valence and anger associations were not significant, all ps > .127.

There were not associations between sadness and private speech use categories. Although there was a trend toward an association between sadness and self-statements, χ^2 (1, N

=107) = 3.578, p = .065, associations between sadness and task and other statements were not significant, χ^2 (1, N =107) = .834, p = .409, and χ^2 (1, N =107) = 2.047, p = .219, respectively. When considering valence, there was a trend toward an association between negative self-statements and sadness, χ^2 (1, N =107) = 3.514, p = .092. All other speech valence and sadness associations were not significant, all ps > .305.

Table 3a

Percent and frequency of emotion expression by private speech references

		Anger		Sadness		Total
		Absent N (%)	Present N (%)	Absent N (%)	Present N (%)	N (%)
Self-Statements	Absent N (%)	16 (15.0)	48 (44.9)	47 (43.9)	17 (15.9)	64 (59.8)
	Present N (%)	2 (1.9)	41 (39.3)	24 (22.4)	19 (17.8)	43 (40.2)
Task Statements	Absent N (%)	16 (15.0)	47 (43.9)	44 (41.1)	19 (17.8)	63 (58.9)
	Present N (%)	2 (1.9)	42 (39.2)	27 (25.2)	17 (15.9)	44 (41.1)
Other Statements	Absent N (%)	12 (11.2)	40 (37.4)	38 (35.5)	14 (13.1)	52 (48.6)
	Present N (%)	6 (5.6)	49 (45.8)	33 (30.8)	22 (20.6)	55 (51.4)
Totals N (%)		18 (24.2)	89 (75.8)	71 (66.4)	36 (33.6)	

Note. Percentages are based on total sample (N= 107).

Table 3b

Percent and frequency of emotion expression by private speech valences

			Anger		Sadness		Total
			Absent N (%)	Present N (%)	Absent N (%)	Present N (%)	N (%)
Self Statements	Positive	Present N (%)	1 (.9)	12 (11.0)	9 (8.3)	4 (3.7)	13 (11.9)
	Negative	Present N (%)	2 (1.8)	39 (35.8)	23 (21.1)	18 (16.5)	41 (37.6)
	Ambiguous	Present N (%)	2 (1.8)	13 (11.9)	10 (9.2)	5 (4.6)	15 (13.8)
Task Statements	Positive	Present N (%)	2 (1.8)	22 (20.2)	16 (14.7)	8 (7.3)	24 (22.0)
	Negative	Present N (%)	3 (2.8)	22 (20.2)	15 (13.8)	10 (9.2)	25 (22.9)
	Ambiguous	Present N (%)	3 (2.8)	30 (27.5)	21 (19.3)	12 (11.0)	33 (30.3)
Other Statements	Reference to other	Present N (%)	5 (4.7)	43 (40.2)	29 (27.1)	19 (17.8)	48 (44.9)
	Ambiguous	Present N (%)	17 (13.5)	21 (16.7)	28 (22.2)	10 (7.9)	38 (30.2)

Note. Percentages are based on total sample (N= 107).

Task persistence. On average, children persisted for a total of 162.78 seconds of the task (*SD* = 93.04, range = 0 to 300). The average number of seconds until task cessation was 235.53 seconds (*SD* = 85.85, range = 0 to 300). Table 4 displays descriptive statistics for dependent variables and covariates. Figure 1 displays the proportion of children persisting (i.e. not yet reaching task cessation) at each second of the Transparent Locked Box procedure.

Table 4

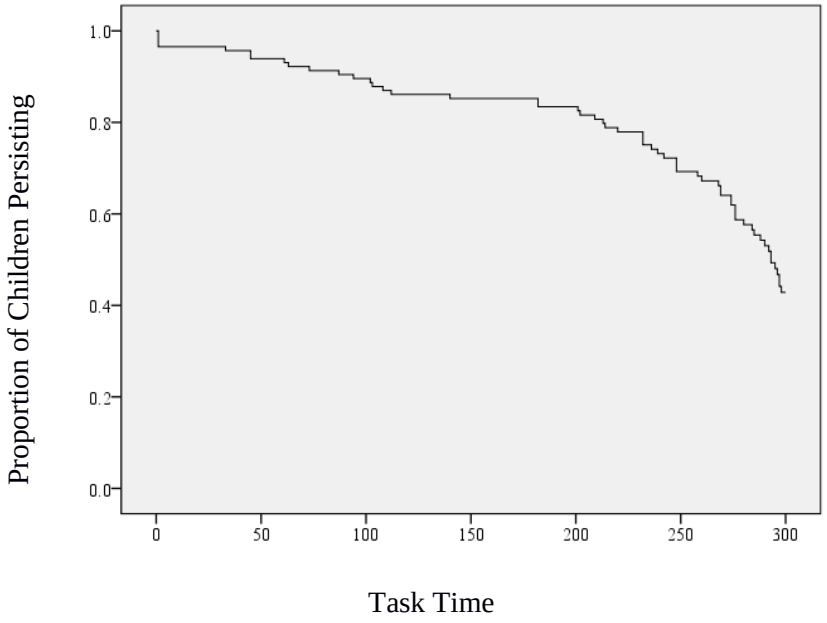
Descriptive Statistics for Covariates and Dependent Variables

	Gender		Total
	Male M (*SD*)	Female M (*SD*)	M (SD)
WPPSI Verbal IQ	100.07 (*17.110*)	100.32 *(13.549)*	100.18 *(15.490)*
Proportion time persisting	.562 *(.283)*	.564 *(.303)*	.563 *(.291)*
Seconds until task cessation	245.613 *(77.516)*	223.944 *(93.923)*	235.526 *(85.853)*

Note. No significant differences between males and females, all *p*s > .176

Figure 1

Baseline cumulative survival function



ANOVA Models

The first ANOVA model tested predicted associations between presence of private speech, the presence of negative emotion expression, and their interaction on the proportion of time persisting. Children's verbal IQ and gender were entered as control variables. Consistent with hypotheses, the presence of negative emotion significantly predicted greater proportion of

time persisting in the task, $F(5, 99) = 8.196$, $p = .006$, $\eta^2 = .112$. On average, children who did not display negative emotion spent proportionally less time persisting ($M = .168$, $SD = .280$) than children who displayed negative emotion ($M = .647$, $SD = .227$). Contrary to hypotheses, however, the presence of private speech did not predict persistence, $F(5, 99) = .316$, $p = .576$, $\eta^2 = .005$, even in interaction with negative emotion, $F(5, 99) = .100$, $p = .753$, $\eta^2 = .002$.

The second ANOVA model tested the association between the type of negative emotion expressed, the type of private speech statement, and all possible interactions on task persistence, again controlling for VIQ and gender. Consistent with hypotheses, the presence of anger predicted greater proportion of time persisting, $F(13, 91) = 16.718$, $p < .001$, $\eta^2 = .155$. On average, children who did not display anger persisted for proportionally less time ($M = .168$, $SD = .280$) than children who displayed anger ($M = .647$, $SD = .227$). In contrast, no other predictors (sadness, self-statements, task statements, other statements) yielded significant main effects, all Fs$(13, 91) < 2.424$, ps $> .123$. There was, however, one significant interaction between task statements and sadness, $F(13, 91) = 4.836$, $p = .030$, $\eta^2 = .050$. All other interactions were not significant, all Fs$(13, 91) < 2.987$, ps $> .087$[1].

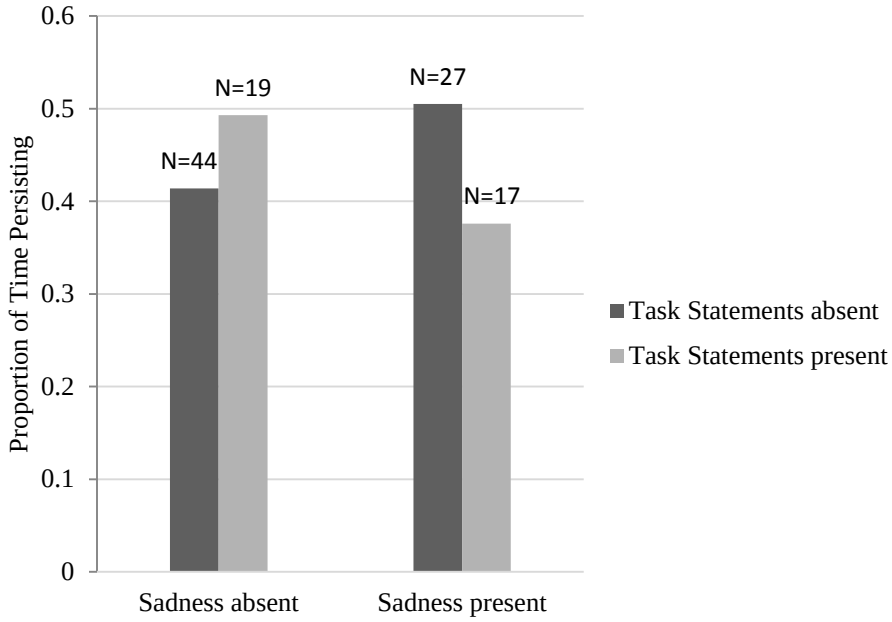
Simple effects tests were conducted to probe the interaction of task statements and sadness. No pairwise comparisons were significant, all ps $> .110$. Given that there is very little literature on the relation of emotion expressions and private speech use, the significant interaction was considered further using effect sizes to facilitate interpretation and guide future research. The presence of task statements was associated with proportionally less time persisting, $F(1, 96) = 2.593$, $p = .111$, $\eta^2 = .026$, but the presence of task statements in the absence of sadness was associated with proportionally more time persisting than the presence of

[1] The interaction between task statements and angry expressions approached significance, $F(13, 91) = 2.987$, $p = .087$. Other interactions were not significant at ps $> .145$.

task statements in the presence of sadness, $F(1, 96) = 2.603$, $p = .110$, $\eta^2 = .026$. Estimated marginal means for each group are displayed in Figure 2.

Figure 2

Presence/Absence of Task Statements and Sadness Predicts Task Persistence



The third exploratory ANOVA model was conducted to determine whether the interaction between sadness and task statements depended upon the valence of task statements. This ANOVA tested associations between the presence of anger and sadness, the presence of positive, negative, and other task statements, and the interaction between sadness and task statements, controlling for VIQ and gender. Results revealed that task statement valence did not moderate the association between sadness and task persistence, all Fs < 1.166, all ps > .328.

Survival Models

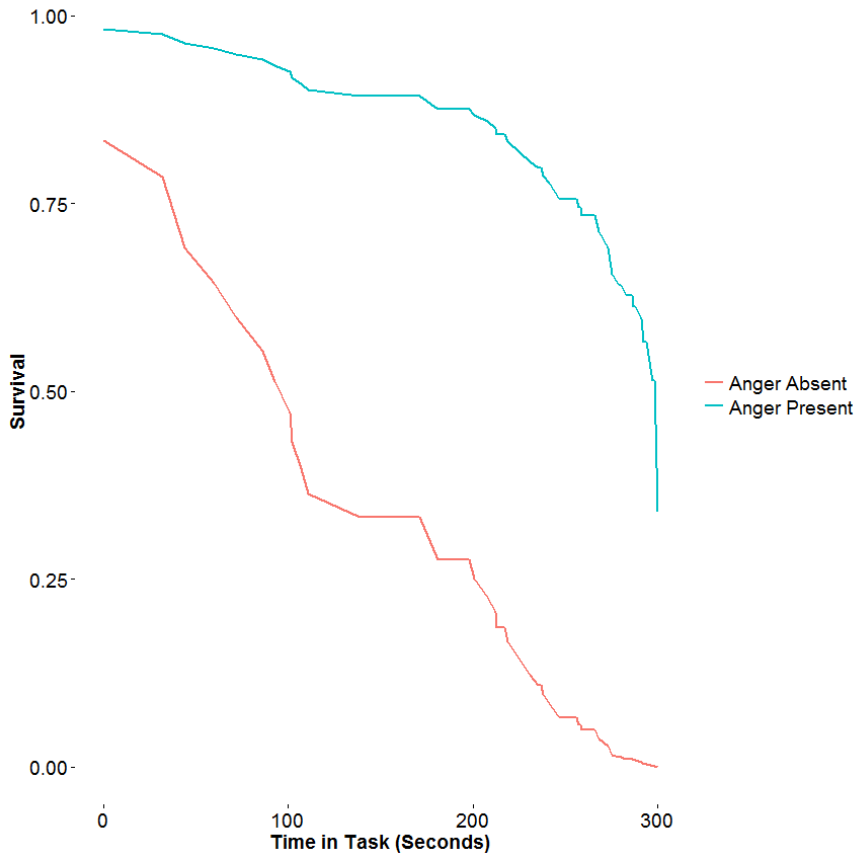
The first Cox regression model was conducted to examine the presence of any private speech, presence of any negative emotion, and their interaction in predicting the likelihood of task cessation, controlling for VIQ and gender. As a reminder, these analyses consider the

presence of emotion expressions and private speech statements as *prior* predictors of task cessation. Consistent with hypotheses, there was a significant main effect of negative emotion, *HR* = .016, $p < .001$, 95% CI [.004, .067]. Children who displayed negative emotion were 62.5% less likely to cease persisting than children who did not display negative emotion. Contrary to hypotheses, private speech did not significantly predict the likelihood of task cessation, *HR* = 1.395, $p = .777$, 95% CI [.139, 13.969], even in interaction with negative emotion, *HR* = .526, $p = .600$, 95% CI [.048, 5.793].

The second Cox regression model was conducted to examine whether the specific type of negative emotion and private speech statement predicted task cessation. Specifically, this model examined effects of the presence of anger and sadness, the presence of self, task and other statements, and all specific emotion expressions by speech statement type on children's task cessation, controlling for VIQ and gender. Consistent with hypotheses, results revealed a significant main effect of anger, *HR* = .107, $p < .001$, 95% CI [.043, .263]. Children who displayed anger were 9.35% less likely to cease persisting than those who did not display anger (Figure 3). Contrary to hypotheses, no other main effects were significant, all *p*s > .126. Further, results revealed a significant interaction between self-statements and anger, *HR* = .053, $p = .041$, 95% CI [.003, .885]. No other significant interaction effects emerged, all *p*s > .099.

Figure 3

Proportion of Children Persisting by Angry Expressions



A third Cox regression model tested whether this association was accounted for by self-statement valence. Results suggested that self-statement valence did not moderate the association between anger and task persistence, all *p*s > .109.

Follow-up analyses. Because 18 children did not display anger during the task, resulting in a sample size of 87, probing interaction effects yielded cells with small *N*s. This limited the ability to interpret the anger by self-statement interaction. To circumvent this limitation, a follow-up analysis focused on continuous variables that allowed more variability in the distribution. By using anger in particular as a continuous variable, rather than dichotomous,

probing the interaction could be conducted using a median split, allowing a larger number of children to be considered for the low anger groups and improving the capacity to interpret a potentially useful interaction.

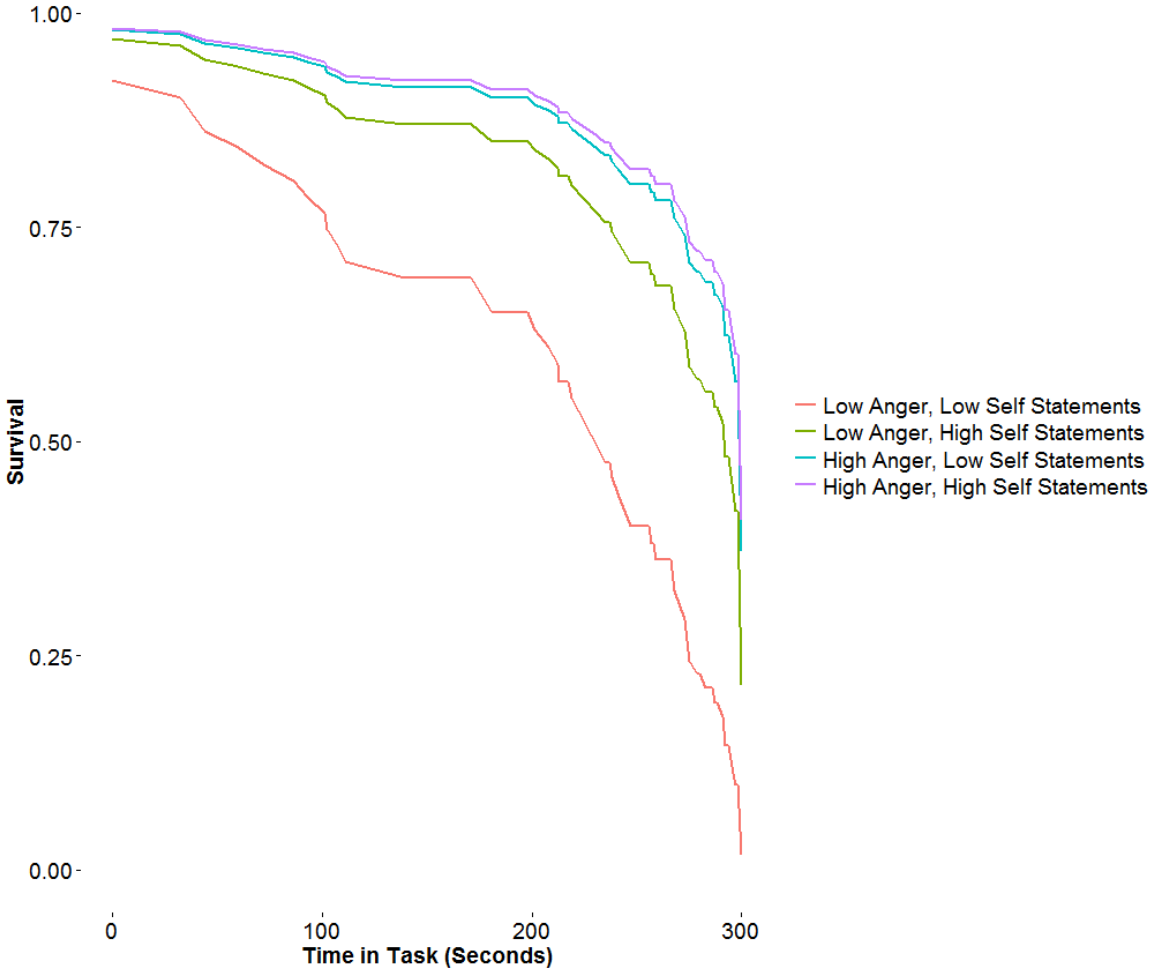
A Cox regression was used to examine the association between the following predictors and task cessation: proportion of time anger was expressed, proportion of time sadness was expressed, frequency of self-statements, frequency of task statements, frequency of other statements, and all emotion expression by private speech type interactions. Consistent with hypotheses and the results of the previously reported models, a greater proportion of time expressing anger was associated with a lower likelihood of task cessation, *HR* = .002, *p* = .010, 95% CI [<.001, .219]. Additionally, there was a significant main effect of self-statements, such that greater frequency of self-statements was associated with lower likelihood of task cessation, HR = .536, *p* = .001, 95 % CI [.378, .762].

Using a median split of anger (Median = .07), the anger by self-statement interaction was probed (Figure 4). Probing revealed that at higher proportions of anger expression, the frequency of self-statements was not related to the likelihood of task cessation. However, at lower proportions of anger expression, the more self-statements children made, the lower the likelihood of task cessation.

One other significant interaction emerged. There was a significant interaction of other statements and anger, *HR* = .146, 95 % CI [.001, .554], *p* = .023. As with self-statements, at higher proportions of anger expression, there was no significant association between other statements and likelihood of task cessation. However, at lower proportions of anger expression, the more often children made other statements, the lower their likelihood of task cessation.

Figure 4

Interaction of Self Statements and Anger



Chapter 4. DISCUSSION

Prior work on the contributions of children's private speech and negative emotion expressions to indices of self-regulation have reached inconsistent conclusions (e.g., Frauenglass & Diaz, 1985; He et al., 2011; Shutz et al., 2000) and, with the exception of one study (Day et al., 2013), neglected to examine these factors in concert. The goal of the present study was to test the individual and combined contributions of nonverbal negative emotion expressions (anger,

sadness) and private speech (references to self, task, or other) to 48-month-old children's task persistence, controlling for children's verbal intelligence and gender. Further, this study examined hypotheses regarding children's negative emotion expressions and use of private speech as predictors using two complementary analytic approaches: the conventional approach of analyzing the overall proportion of time children persisted at the task and an approach that capitalizes on the time series, specifically survival analyses that investigated the predictors that occurred before children ceased persisting. Below results are summarized, and limitations and implications are discussed.

Overall negative emotion and task persistence

The hypotheses that both overall negative emotion and private speech would account for persistence during a challenging task were partially supported. For each analytic approach negative emotion expression, but not private speech use or their interaction, was associated with task persistence. That is, whether analyses predicted the proportion of task time children persisted or the likelihood that they would cease persisting, negative emotion expression was a significant predictor of greater persistence. These findings diverged from another study in which student-reported anger, anxiety, and boredom negatively predicted motivation (study interest, effort) on self and positively predicted task-irrelevant thinking (Pekrun et al., 2002). However, this study focused on observed rather than self-reported emotion, and a younger sample of children. Further, the present results were consistent with the functional perspective on emotional development, according to which regulated emotions enable adaptive functioning, even if negative in valence (Barrett & Campos, 1987). Moreover, this perspective asserts that anger and sadness serve different functions (approach, withdrawal) that should have different implications for children's task persistence, as discussed next (e.g., Adams et al., 2006).

Anger, Sadness and Persistence

The functional theoretical perspective posits that anger functions to motivate effort to overcome obstacles, whereas sadness functions to enable relinquishment of goals and seeking support of others (Adams et al., 2006; Barrett & Campos, 1987). Thus, a second set of hypotheses predicted that anger would predict greater task persistence whereas sadness would predict less task persistence. This set of hypotheses also yielded partial support. Results of these analyses indicated that the best predictor of greater task persistence was the presence of anger, both in terms of proportion of task time children persisted and in terms of the likelihood of task cessation. Although results did not support the hypothesis that sadness would predict less task persistence in any analyses, sadness also did not predict increased task persistence.

Thus, with regard to the role of children's negative emotions in facilitating or hindering persistence at a challenging task, the findings partially supported the functionalist view of emotion. That is, results supported the view that anger enables acting with increased effort when a goal is blocked (e.g., Carver & Harmon-Jones, 2009). Results from survival models additionally provided support for the directionality of this relation. That is, presence of anger prior to task cessation predicted the likelihood of delaying this event. These findings also contribute to a small but consistent set of empirical findings illuminating the ways that anger can aid young children's self-regulation (He et al., 2011; Perry, 2010).

In understanding this result, it is important to note that 96.8% of children's nonverbal angry expressions during the task were characterized as low intensity. That is, the expressions usually entailed a single nonverbal cue of anger, such as angry muttering or a furrowed brow, or a few fleeting cues of anger, such as a brief brow furrow and pressing of the lips. The functional value of low-level anger in task persistence can be contrasted with the findings of studies with clinical samples. Clinical interventions for children displaying behavior problems incorporate

training to monitor and reduce the intensity of angry outbursts that can lead to disruptive behaviors (e.g., Greenberg, Kusche, Cooke, & Quamma, 1995; Havighurst, Wilson, Harley, Kehoe, Efron, & Prior, 2013). In this sample of typically developing 48-month-olds, there was limited variability in anger intensity. Clinical samples, or younger children, are likely to provide more range in anger intensity. For example, an unpublished study with the present sample at age 36 months found that children's task persistence in one second was predicted by low intensity anger in the previous second, whereas disruptive behavior was predicted by higher intensity anger in the preceding second (Perri, 2010). Together, the evidence from the present thesis and previous work highlights the need to consider anger intensity in future work, particularly with regard to understanding the functionality and adaptiveness of anger for children's self-regulation.

Contrary to hypotheses, sadness was not associated with decreased task persistence, regardless of the analytic approach taken. As noted, a functional perspective defines sadness as the appraisal that a goal is lost and cannot be recovered, and posits that sadness elicits withdrawal or relinquishment of the goal (Barrett & Campos, 1987) and seeking of social support (Abe & Izard, 1999). In terms of goal withdrawal, studies have found that after a goal was blocked, infants' and toddlers' angry expressions were associated with increased persistence, whereas sad expressions were not (Lewis, Alessandri, & Sullivan, 1990; Lewis, Sullivan, & Kim, 2015). Thus, consistent with the present study's findings, sadness was unrelated to behavioral measures of persistence. Although sadness was not related to *decreased* action tendency in either study, the lack of relation to behavior could be interpreted as withdrawal. In a follow-up study, psychophysiological measures indicated that angry expressions were related to greater heart rate and sad expressions were related to greater cortisol levels (Lewis, Ramsay, & Sullivan, 2006). These differences in physiological arousal were interpreted

as evidence that infants expressing sadness were physiologically stressed and thus withdrawn in response to the goal blockage. Thus, future research may consider whether withdrawal from a goal may be better captured by measures such as psychophysiological response rather than observable behavior.

With regard its social functions, it is possible that sadness was less functional in the Transparent Locked Box procedure, as children complete the task alone. Indeed, one study found that sad expressions in 24-month-olds were more likely to occur when toddlers looked to their mothers during stressful tasks than when they did not (Buss & Kiel, 2004). Further, greater social speech, i.e., speech directed at others, has been associated with greater sad expressions in a study of four-and-a-half- to six-year-olds (Day & Smith, 2013). Thus, conditions of the Transparent Locked Box procedure may have decreased the opportunity for children to capitalize on this social function of sadness. Indeed, only 29.7% of children displayed any sadness during the task, compared to 75.8% of children who displayed anger. As the Transparent Locked Box procedure was designed to elicit frustration (Goldsmith et al., 1995), this is not surprising. Nonetheless, that children displayed any sadness is indicative of the appraisal process embedded in a functionalist perspective of emotion (Lazarus, 1991).

Moreover, 92% of children who expressed any sadness in the task also expressed anger. Thus, future work that disentangles the contributions of these discrete emotions further is warranted. For example, measuring the relative likelihood of behaviors that follow anger and sadness may be an informative next step for understanding their respective roles in self-regulation. Another direction for future research would be to analyze sequences of anger and sadness expressions. It is likely that there are changes in emotions over the course of a frustrating task, and these may reflect ongoing changes in action tendencies. For example, in our study we

have observed the following trajectory among some children: initially the child develops a low intensity angry expression as the child persists, but later in the task the child begins to display sadness and gives up momentarily, resuming effort after a pause. Examination of different emotion trajectories calls for a statistical approach examining time-varying effects of emotion expression and action tendency, or an examination of emotion expression that occurs *after* the event of task cessation.

Private Speech and Task Persistence

In addition to investigating the role of children's negative emotions, the present study also investigated the role of private speech in children's task persistence. Based on mechanisms proposed by Vygotsky (1934/1962), it was hypothesized that task statements would predict greater task persistence. However, an alternative hypothesis was that based on Carlson (2005), the content of private speech would not matter, as any private speech may provide psychological distancing. Contrary to both hypotheses, whether children engaged in private speech, or whether they engaged in particular forms of private speech (self, task, or other references), no main effects on their task persistence were found. This diverges from previous studies finding that private speech in children this age was related to indices of self-regulation (e.g., Diaz & Berk, 2014; Harris, 1990). Yet, several studies reported null or marginal results (Frauenglass & Diaz, 1985).

To understand these mixed results, several studies investigated the degree to which spontaneous private speech frequency depends on the type of task in which the participants are engaged. Task characteristics including verbal/semantic task content, challenging but not impossible difficulty and open-endedness were all related to greater frequency of private speech (Frauenglass & Diaz, 1985; Berk; Krafft & Berk, 1998). Although over half of children engaged

in private speech in this sample, understanding how task characteristics may also influence the *usefulness* of private speech may be an important future research direction. For example, although verbal/semantic task content was related to greater private speech use in one study (Frauenglass & Diaz, 1985), another study found that using verbal self-instruction during a verbal word recognition task interfered with children's performance (Cole & Newcombe, 1983).

Another explanation for the failure to find main effects of children's private speech use is related to the developmental course of private speech. Among the 48-month-olds who did not engage in overt private speech, some may not yet have been using overt private speech while others may have already transitioned to more covert private speech. In this sample, 66.6% of children used at least one unintelligible utterance (i.e., mumbles, whispers). In the research on private speech, these vocalizations have been used to measure the onset of internalized speech (e.g., Winsler et al., 2005). Thus, it appears likely that many children in this sample already began the transition to partially internalized speech. Further, there was little age variation in the sample of 48-month-olds in the present study. For future work, studies varying both children's age and task characteristics may shed more light on how children's relative use of private speech to social or partially internalized speech relates to self-regulation and as a function of task type. Nonetheless, the literature on children's private speech has not attended to the children's emotion expressions during tasks. Thus, the effects of private speech, or of certain categories of private speech, may have depended on the nature of children's emotional relation to the task, which is addressed in the next section of the discussion.

Interplay of Private Speech and Negative Emotion

The last set of findings in the present study involved interactions between children's nonverbal emotions expressions and types of private speech used. One interaction involved

anger and private speech referencing the self, and one involved sadness and private speech referencing others or with an ambiguous reference.

Survival analyses yielded an interaction of the presence or absence of angry expressions and of self-statements. Interpretation of this interaction was qualified by the fact that only two children belonged to the angry expressions absent/self-statements present group, and sixteen belonged to the angry expressions absent/self-statements absent group. Follow-up analyses using continuous variables were conducted to help interpret this interaction. Self-references, whether positively- or negatively-valenced, were associated with lower likelihood of task cessation when children expressed less anger. In other words, as long as anger was not too frequent, children's self-statements were associated with delayed task cessation. However, among children who expressed higher proportions of anger, the frequency of self-statements was not related to the likelihood of task cessation. A similar interaction was found for the frequency of other statements and proportion of time angry, suggesting that it was some types of private speech, rather than self-references specifically, that had this facilitative effect on task persistence for children expressing lower proportions of anger.

The interactions of anger with self-reference and with other references can be interpreted in several ways that lead to future research directions. First, children expressing anger in higher proportions may have sufficient to motivation to persist, regardless of private speech use. However, one hypothesis for future research is that when anger is expressed less, the use of self and other statements serve as an alternate regulatory strategy to help children to persist. This hypothesis would be consistent with one study's finding that private speech use was related to better task performance in children with behavior problems (Winsler et al., 2007). In particular, articulating thoughts about oneself using self-statements may provide psychological distancing

from the distress of task demands, consistent with work on verbally-mediated appraisals (Ayduk & Kross, 2010; Kross & Ayduk, 2011), and on symbols and psychological distancing (Carlson, 2005). Other statements may provide psychological distancing as well, serving as a distraction from the task. In contrast, task-reference statements (as measured in this study) may not afford children this opportunity to gain psychological distance from task demands. Additionally, an important next step in understanding the mechanisms by which anger, self-statements, and other statements influence each other and task persistence would be to consider the sequence in which these events occur. Understanding patterns in these sequences may shed light on how and when the emotional context of private speech use precisely influences successful self-regulation.

Interpretation of the significant interaction between the presence/absence of task-reference statements and of sad expressions was limited by the fact that none of the cell comparisons were significant. However, as previous research has not delved into the nature of relations between children's emotions and their private speech, cautious interpretation using effect sizes was conducted to inform future research efforts. Examination of the effect sizes of these comparisons indicated that children who expressed sadness and did not make task references, or expressed no sadness but made task references spent the largest proportion of time persisting. Thus, it may be that task statements are helpful for persistence when children do not display sadness, but may hinder persistence when children display sadness. One potential explanation would be that the types of task statements children used differed depending on whether they were sad, in a way that the coding scheme did not capture. However, inspection of the transcripts did not suggest that is explanatory. Task-referencing statements, regardless of whether a child displayed sadness or not, were most often related to the toy (*Care Bear, I want to see you*; *That car*) or the task characteristics/demands (*It's locked*; *I want my key in*). Further,

this result is interesting to interpret in light of the fact that no such interaction was significant in survival analyses. Thus, it is possible that task statements and/or sadness play a more prominent role in task persistence *after* task cessation has occurred. Future work examining variables after event occurrence or using time-series analysis could shed light on this question.

Methodological Approaches to Task Persistence and Cessation

A secondary aim of this paper was to address a limitation in the literature of young children's self-regulation by using a methodological approach that capitalized on the time series, in addition to traditional methodology that collapses across time. These analytic approaches captured two complementary perspectives on the role of anger and, to a lesser degree, private speech on children's persistence, both of which may be important for children's self-regulation. First, approaches were consistent in revealing that the presence of anger was associated with task persistence. ANOVA models suggested that the presence of anger was associated with proportion of time persisting across the task. Survival analyses extended this finding by indicating that the presence of anger *prior* to task cessation predicted greater likelihood of it occurring later in the task. Thus, survival analyses allowed for more directional conclusions about the function of anger and greater precision in understanding when this relation occurs in the time series.

In contrast, interaction effects of private speech and emotion expressions differed depending on the analytic approach. ANOVA models revealed a significant interaction between task statements and sadness, while survival models revealed a significant interaction between self-statements and anger. Taken together, one implication of these results is that different types of private speech and discrete emotions may be important at different points in the time series. As previously discussed, it is possible that anger and self-statements are particularly important

for understanding factors that influence the onset of children's task cessation. One question these findings raise is whether task-statements and sadness are more important *after* a child's task cessation. Such distinctions between when behaviors and emotions impact self-regulation would be crucial for developing effective interventions.

Limitations and Future Directions

As previously noted, this study had several limitations. First, studies with a larger sample size would afford greater power for analyses, allowing for better interpretation of interaction effects in particular. Second, although the coding scheme for private speech content in this study was based on theoretical functions, the codes used may not have effectively captured differences that are relevant to self-regulation. Future work could test the functionality of private speech using alternate or adapted coding schemes that may better capture distinctions in children's self-regulation. Particularly for task-statements, certain forms such as problem-solving statements might be facilitative, whereas others might hinder persistence. Third, the Transparent Locked Box procedure was optimal for studying private speech and emotion regulation in that it provided less ambiguity regarding what was considered social versus private speech and it elicited negative emotion. However, future work could consider tasks with different characteristics in order to better understand task-related differences in the functional role of private speech. Further, conducting studies with multiple age groups or a single age group with a larger range would allow for a better understanding of children's developmental level of social, private, and partially internalized speech use. Considering all of these categories may increase our understanding of when and for whom private speech serves a facilitative role in self-regulation. Finally, as mentioned, it is also worth considering that children who expressed sadness were also more likely to express anger. Further studies could use sequential analyses to

parse which emotion expressions are likely to be preceded and followed by children's persistence.

Conclusions

In sum, the present thesis investigated the individual and combined contributions of 48-month-olds' nonverbal negative emotion expressions and private speech use to task persistence. Findings highlighted the functional role of anger for increasing the proportion of time children persisted and decreasing the likelihood of task cessation. Further, findings supported the notion that the function of private speech use depended on speech content and emotional expressions. For children who displayed lower proportions of anger, using self-statements or other statements were associated with lower likelihood of task cessation. Thus, private speech that does not reference the task may serve as a self-regulatory strategy for children when anger is less frequent, perhaps due to increased psychological distancing from the task demands. This study also points to several limitations in the measurement in private speech categorization and perhaps to its relevance for capturing elements of children's self-regulation.

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