The Relation of Attentional, Emotional, and Social Regulation to Cognitive Competence, from Infancy to School Entry

by

Fiona K. Miller

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Department of Psychology
Brock University
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Abstract

Recent research on the sources of cognitive competence in infancy and early childhood has highlighted the role of social and emotional factors (for example, Lewis, 1993b). Exploring the roots of competence requires a longitudinal and multivariate approach. To deal with the resulting complexity, potentially integrative theoretical constructs are required. One logical candidate is self-regulation. Three key developmental questions were the focus of this investigation. 1) Does infant self-regulation (attentional, emotional, and social) predict preschool cognitive competence? 2) Does infant self-regulation predict preschool self-regulation? 3) Does preschool self-regulation predict concurrent preschool cognitive competence? One hundred preschoolers (46 females, 54 males; mean age = 5 years, 11 months) who had participated at 9- and/or 12-months of age in an object permanence task were recruited to participate in this longitudinal investigation. Each subject completed four scales of the WPPSI-R and two social cognitive tasks. Parents completed questionnaires about their preschoolers' regulatory behaviours (Achenbach's Child Behavior Checklist [1991] and selected items from Eisenberg et al. [1993] and Derryberry & Rothbart [1988]). Separate behavioural coding systems were developed to capture regulatory capabilities in infancy (from the object permanence task) and preschool (from the WPPSI-R Block Design). Overall, correlational and multiple regression results offered strong affirmative answers to the three key questions (R's = .30 to .38), using the behavioural observations of self-regulation. Behavioural regulation at preschool substantially predicted parental reports of regulation, but the latter variables did not predict preschool competence. Infant self-regulation and preschool regulation made statistically independent contributions to competence, even though regulation at Time 1 and Time 2
were substantially related. The results are interpreted as supporting a developmental pathway in which well-regulated infants more readily acquire both expertise and more sophisticated regulatory skills. Future research should address the origins of these skills earlier in infancy, and the social contexts that generate them and support them during the intervening years.
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Dedication

I dedicate this thesis to my family (Mom, Dad, Mairi, Morag, James, Kevin, Frank, Siobhan, and Declan) for their love and support throughout my university education. I thank them for expressing this support physically (during my many moves of residence), emotionally (via visits and the phone), and financially.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Method</td>
<td>16</td>
</tr>
<tr>
<td>Results</td>
<td>27</td>
</tr>
<tr>
<td>Discussion</td>
<td>58</td>
</tr>
<tr>
<td>References</td>
<td>61</td>
</tr>
<tr>
<td>Appendixes</td>
<td>66</td>
</tr>
</tbody>
</table>
List of Tables

Table 1
Composite Variables of Infant Regulation

Table 2
Composite Variables of Preschool Regulation

Table 3
Means and Standard Deviations of Cognitive and Social-Cognitive Measures, Parental Reports of Child Regulation, and Parental SES

Table 4
Correlation Matrix of Infant Regulation Composite Variables, Cognitive and Social-Cognitive Measures

Table 5
Preschool Cognitive Performance Predicted by Infant Regulation Variables, Simultaneous Multiple Regressions

Table 6
Correlation Matrix of Infant and Preschool Regulation Composite Variables

Table 7
Preschool Regulation Predicted by Selected Infant Regulation Variables, Simultaneous Multiple Regression

Table 8
Correlation Matrix of Preschool Regulation Composite Variables, Cognitive and Social Cognitive Measures

Table 9
Preschool Cognitive Competence Predicted by Preschool Regulation Variables, Simultaneous Multiple Regressions
Table 10
Prediction of Competence by all Observational Infant and Preschool Regulation Variables

Table 11
Cognitive Competence Predicted by Parental Reports of Preschool Regulation

Table 12
Selected Preschool Regulation Composite Variables as Predictors of Parental Reports of Preschool Regulation
In infancy sensorimotor development has been viewed as the center of infant cognitive growth, while infant-caregiver interactions are the focus of socio-emotional development. Current research has revealed consistent patterns of behaviour within and between social and cognitive domains from infancy to early childhood (Bornstein & Sigman, 1986; Cassidy, 1988; Lewis, Feiring, McGuffog, & Jaskir, 1984; Lyons-Ruth, Alpern, Repacholi, 1993). Although much of this research has focused on unidirectional relationships, charting both within- and between-domain connections, more recent research has yielded evidence for the reciprocal, bi-directional nature of emotion-cognition development (Lewis, 1993b). Such findings focus our attention on fundamental questions about the nature of developmental continuity across domains.

Investigation of such patterns of human diversity in early life is a central theoretical and applied question for several reasons. It is a critical or sensitive period for a wide range of outcomes, including health, well-being, competence and coping (Keating & Mustard, 1993). Keating (in press) has summarized the key arguments against the traditional dichotomy of nature versus nurture as the more important source of human diversity:

We need to know more than how to apportion the amount of influence exerted by two competing categories [of nature and nurture], each of which is so broad as to be almost wholly uninformative. We need to know how human competence and human coping actually develop as self-organizing dynamic systems. We need to move beyond these traditional dichotomies in order to generate a coherent conceptual understanding of developmental diversity that is methodologically rigorous, empirically sound, and practically useful for educational transformation. (p. 28)

In order to search for coherence in the complexity that results from examining the roots of competence in a multidimensional and longitudinal
fashion, it is important to explore potentially integrative theoretical constructs. One logical candidate is self-regulation. Self-regulation is a capacity that demands skills from both the socio-emotional and the cognitive developmental domains. In infancy, self-regulation involves both attentional and emotional regulatory capacities. These abilities have been identified as key self-organizing systems that are predictive of later social and cognitive competence (Fogel & Thelen, 1987; Gottman & Katz, 1989; Kopp, 1989; Lewis, 1993a, 1993b; Tamis-LeMonda & Bornstein, 1989).

The purpose of the study reported here was to explore the role of infant self-regulation in early childhood competence. In this study, early childhood competence was defined to include cognitive competence using standardized assessments, social-cognitive competence using tasks designed to tap inferential skills in social and psychological domains, and self-regulatory capabilities in the performance of a cognitively demanding task. There are several developmental pathways through which early patterns of self-regulation (both attentional and emotional) might influence later competence. One pathway may be through early self-regulation to subsequent self-regulation, with indirect effects via the influence of concurrent regulatory capabilities on competence at the preschool time. Another pathway may involve direct effects of early self-regulation on later competence, attributable to a more effective “learning system” in operation during the intervening period. In this pathway, optimal patterns of self-regulation may enable the more rapid acquisition of developmental skills, through more effective habits of learning, including more easily self-directed attention or more balanced regulation of one’s emotions. It is possible, perhaps even likely, that both effects operate across this sensitive period of development, during which
many critical cognitive and other competencies are being acquired (Case & Okamoto, in press; Keating, in press).

Given the potentially integrative role of self-regulation in infancy and early childhood, the relevant literature on this topic is reviewed first. This is followed by an overview of research that has explored how this construct might be related to the development of cognitive and social-cognitive competence.

Self-regulation from infancy to early childhood

Self-regulation involves the ability to manage one's emotions and one's attention. During infancy, attentional regulation refers to the baby's ability to focus on, attend to, and persist in accomplishing a task (Lewis, 1993a). An infant for example, who is motivated to continue playing a hiding game, may focus on the location where a toy was hidden so that she/he can continue to attend to, and possibly find the object. Similarly, emotional regulation also refers to infantile coping mechanisms and involves a baby's capacity to control high levels of experienced positive and negative affect (Fox, 1989; Kopp, 1989). An infant, for example, might mouth his/her hands or rock back and forth to cope with distress. Throughout the first year of life, infants develop repertoires of behaviours that they use to self-regulate in novel and arousing situations (Mayes & Carter, 1990; Stifter & Moyer, 1991). It is possible that patterns of self-regulation are developed during infancy and that these patterns affect the development of coping skills and competence (skill acquisition).

Self-regulatory behaviours should be viewed within a context. If they are observed as static and discrete, they lose their scientific meaning. This theoretical notion, borrowed from the attachment literature, is the revelation that the same behaviours may be used in service of different organizational
systems (Ainsworth, Belhar, Waters, & Wall, 1978; Sroufe, 1979). That is to say that specific behaviours (i.e., attending to an object, reaching for an object, or sucking on one's hand) may be used by socio-emotional and/or cognitive systems to accomplish similar or contrasting goals. It is therefore plausible that identical acts may serve different functions when recruited by individual systems in varying contexts.

Throughout infancy, a baby may become distressed because of internal reasons, such as hunger or pain, or because of external reasons such as overstimulation or violations of expectations (Tronick & Gianino, 1986). However, during the second six months of life, infants display a shift from internally directed regulatory mechanisms to externally directed regulatory capacities (Mayes & Carter, 1990). Internal mechanisms include self-soothing behaviours such as sucking, rocking, and ear rubbing as well as those behaviours that limit a baby's perception of external stimuli, such as gaze aversion. Yet, an infant's repertoire of internal behaviours are limited and they are often too immature, disorganized, and uncoordinated to comfort a baby. Hence, babies need to develop externally directed behaviours to achieve regulation (Gianino & Tronick, 1986; Mayes & Carter, 1990).

To regulate externally, the infant signals the caregiver for help through behaviours such as smiling, cooing, babbling, crying, and fussing. Here, the success of the infant's regulation is dependent on sensitive caretaking. An infant, for example, may attempt to grasp an object that is out of his/her reach and become distressed or angry. If the caregiver notices this and puts the object within the baby's reach, the baby may regulate his/her affect enough to manipulate the object. For some infants, the distress might have been too arousing and it would require the caretaker's verbal and physical soothing of the infant before the baby was in a state where he/she could attend to the
object. As Tronick and Gianino (1986) state in their Mutual Regulation Model (MRM), the responsivity of the caregiver has a strong impact on the development of the infant's external regulatory abilities. The infant's attempts to modulate pass through a feedback loop that includes the caregiver. Hence the baby's regulatory success is dependent on his/her ability to emit cues and the caregiver's ability to read them.

Normal infant-caregiver interactions alternate between well and poorly regulated states (Tronick and Gianino, 1986). However it has been proposed that a dyad characterized by successful regulation will enable the infant to do the following: further his/her regulatory skills; develop a representation of the dyad's interaction as regulated and reparable; develop a positive affective core with clearly defined notions of self and others; and as well, use this representation to engage in and structure interactions with others (Tronick and Gianino, 1986). Conversely, an infant from a poorly regulated dyad may continue to rely inappropriately upon or develop internal regulatory mechanisms to modulate his/her arousal. Externally oriented regulatory strategies are essential for social and cognitive development (Lewis, 1993a; 1993b; Mayes & Carter, 1990). To reiterate, an infant's regulatory style may determine his/her level of future social-cognitive competence. It will shape the frequency and quality of social interactions that the infant will engage in.

Presumably, regulated and dysregulated infants will experience different developmental pathways throughout infancy and early childhood. Those infants who only recruited internal behaviours, for example, may withdraw from the peer group, be recognized as deviant, and become socially isolated. Similarly, those infants who developed an inadequate repertoire of
external behaviours may display aggression, be recognized as deviant, and also become socially isolated.

Social isolation may put these children at further risk for the development of inadequate social and cognitive skills. Concurrent preschool measures of regulation have shown that well regulated children are good problem solvers, more able to compromise and meet mutual needs when playing with peers, able to make new friends (Frankel & Bates, 1990), likely to develop peer interaction skills through higher levels of play (Gottman, & Katz, 1989), more popular, and more likely to engage in positive peer relationships (Eisenberg et al., 1993). In contrast, dysregulated preschoolers express anger as aggression, are less sociable, and are less likely to receive positive responses from their peers after displaying helping behaviour (Eisenberg & Fabes, 1992). They are at risk for delinquency (Rubin, Hymel, Mills, & Rose-Krasnor, 1991), may feel anxious and lonely, and are denied opportunities for social-cognitive development.

Cognitive, social-cognitive, and self-regulatory competence

Investigations of the relationship between a range of infant characteristics and standard cognitive competence have been cited above (Tamis-LeMonda & Bornstein, 1989; Lewis, 1993b; Bornstein & Sigman, 1986). Cognitive competence has traditionally been viewed as a direct manifestation of underlying intelligence. In the last two decades, however, general intelligence has become increasingly difficult to isolate in a meaningful way, cognitive processing differences have proved an inadequate alternative model, and environmental and motivational factors have been assigned a greater role in cognitive outcomes (Keating & MacLean, 1987; Sternberg, 1985). During the same period, social and personality developmentalists have increasingly emphasized the impact of children's close relationships on their
cognitive functioning (Belsky, 1981; Wachs & Gruen, 1982). Cognitive adaptations to social relationships have come to be seen as the foundations for cognitive activity in all domains of the child’s interaction with the world. The convergence of these trends has set the stage for current research into social-cognitive and social-emotional influences on cognitive competency.

Several implications arising from this work should be highlighted. First, relationships between earlier and later performance are generally stronger for interactions than for main effects, even when the main effect predictions are within the same domain. Socio-emotional predictions to later cognitive competence are often as strong or stronger than predictions from prior cognitive performance (Lewis, 1993b). This fits well with a second point: studying the integration over time of various developmental subsystems (here, attention regulation, emotion regulation, and cognitive performance) is likely to be more informative than those restricted to a single domain. Similar critiques of "central" or "direct correspondence" theories have emerged from work within domains of development such as cognition (Keating & MacLean, 1988), emotion (Camras, 1992; Campos, 1994), and attachment (Sroufe, 1979). Finally, these findings make a strong case for the validity and utility of a functionalist or contextualist approach (e.g., Campos, 1994) to the study of early development. Molar or global coding systems that permit the incorporation of behavioural context show considerable promise as reliable and theoretically robust predictors of developmental pathways.

In the study reported here, standardized assessments of cognitive competence were used for several reasons. First, it permits an effective comparison to a broad range of cognitive outcomes that have been studied over many years. Four subscales of the WPPSI-R were selected to arrive at a reasonable and logistically feasible assessment of standardized intelligence.
One of the WPPSI-R subscales, the Block Design, afforded an excellent opportunity to explore two issues in more depth. First, as a novel and increasingly difficult problem-solving task, it allowed the investigation of preschool children's self-regulatory capabilities under challenging conditions. Second, the format was similar to the conditions under which infant regulatory capabilities were observed and coded.

In order to examine preschoolers' cognitive competence in a broad fashion, their level of social-cognitive development was also assessed. Social-cognition involves one's knowledge and understanding of another's thoughts, feelings, and of their behaviour in social interactions. Before four years of age, preschoolers are egocentric and cannot demonstrate an awareness of the possible discrepancy between their own and other's thoughts about the world (Gove & Keating, 1979). Further, preschooler's cognitions are centered so that they cannot understand that two objective views of the same reality may exist (Gove & Keating, 1979).

It appears that much of the literature on children's social-cognitive development has focused on the age at which children acquire perspective taking skills rather than the factors which affect the development of these abilities. Recent research has shown that the number of siblings a child has influences their acquisition of a "theory of mind" (Perner, Ruffman, & Leekam, 1994). That is, three-year-olds with one or more siblings act like four-year-olds with regard to their perspective taking abilities (Perner et al., 1994). The experience of having a sibling enables young children to take on other's perspectives at an earlier age (Perner et al., 1994). Two standard measures are being used to assess social-cognitive competence (Chandler & Lalonde, in press; Gove & Keating, 1979).
Gove and Keating (1979) investigated young children's empathic role taking abilities. Three and five-year-olds were told two types of stories and asked to make empathic inferences about the characters' feelings in these common situations. In the first type of story, a situational inference story, subjects could make a judgment about the characters' feeling state based solely on the situational events. Here the characters received or did not receive an award and the character's facial cues could not be seen. In the second type of story, a psychological inference story, subjects were also asked to infer how the characters felt. Here, both characters received the same award but their contrasting facial cues (happy or sad) were displayed to the subject.

These researchers predicted that younger, more egocentric children, would perform well on the situational inference story and less well on the psychological inference story because they would be able to project their own feelings about receiving or not receiving an award onto the story character. Generating an inference about a character's psychological state in the second type of story would demand higher role taking skills and would be more difficult for the three-year-olds than it was for the five-year-olds.

As hypothesized, a story effect was found in that the five-year-olds performed better on the psychological inference stories than the three-year-olds. Two age effects were found in that the older children were more able than the younger children to identify the character's emotional state and generate an explanation as to why the character might be feeling that way. It was concluded that younger children understand feelings as a part of an event, rather than a subjective experience of an event. As their perspective taking skills develop, they understand that feelings can be independent of situations (Gove & Keating, 1979).
More recently, Chandler and Lalonde (in press) have examined perspective taking skills in five to seven-year-olds by asking them to respond to questions about pretend others' thoughts (Raggedy Ann and Andy). These children were given more information about the situation than the story characters were and it was predicted that younger children’s egocentric nature would prevent them from accurately describing the pretend other’s perspective. That is, they would assume that their subjective reality was an objective reality.

In contrast to previous research in this area, Chandler and Lalonde (in press) hypothesized that children advanced their perspective taking skills beyond four years of age; an age by which children have developed an awareness of other's mental states. These researchers agreed with previous research in their findings that children can represent other people's mental life by four years of age, but that this representation was quite different from an interpretive or constructive grasp of mental states. That is, young children’s understanding that other's may have false beliefs is quite different from the understanding that reality can be subjectively constructed. These researchers proposed that children have a representational theory of mind by four years of age and that they develop a constructive theory of mind from five to seven years of age.

To test their hypotheses, they asked five, six, and seven-year-olds to answer questions about pictures where the characters (Raggedy Ann & Andy dolls) were only shown parts of the entire picture that the child had seen. In the first condition, subjects were tested on their ability to understand that a doll (imagined to be real) could maintain a false belief. In condition two, subjects were tested on their ability to generate two views of the same reality. That is, the experimenter asked the child what both dolls would think about
the same picture. Finally, in the third condition, subjects were told that the
dolls disagreed (i.e. that they did not view the picture in the same way) and
subjects were forced to generate two different views of the same objective
reality. This third condition was used to test the subject's understanding that
reality could be constructed.

As hypothesized, older children displayed a constructive
understanding of mental life while younger children showed a
representational understanding of mental life. Concordant with previous
research, 53% of 5 and 6-year-olds and 100% of 7-year-olds understood that
another could hold a false belief. Specifically 20% of 5-year-olds, 33% of 6-
year-olds, and 88% of 7-year-olds displayed an awareness that reality could be
constructed. Chandler and Lalonde (in press) concluded that holding a
representational theory of mind was different from, and a precursor to
holding a constructive theory of mind.

Slightly modified versions of these two tasks were chosen to assess
social-cognitive competence in the children returning to the laboratory at 4 to
6 years of age. They were chosen for a few reasons. First, they assess two
components of social-cognitive skill. The inference task (Gove and Keating
1979) examines children's understanding of feeling states while the theory of
mind task (Chandler and Lalonde, in press) looks at children's
understanding of false beliefs and the construction of reality. The first task
has a ceiling effect in that the majority of the five-year-olds could accurately
infer a psychological inference. In contrast, the latter task is more difficult
and presumably, there will be a greater range of variance in the answers. Few
of the five and six-year-olds showed an interpretive theory of mind. Both
tasks are appropriate to assess social-cognitive skills in the four to six year old
age group.
The relationship between self-regulation and the development of social-cognitive skills has not received extensive investigation. As previously noted, research examining concurrent measures of regulation and social skills has shown that well-regulated children have more positive peer relationships where they are able to develop their social skills. Conversely, poorly-regulated children have negative relationships and therefore lack opportunities to develop social competence (Eisenberg & Fabes, 1992; Rubin et al., 1991).

It may therefore be the case that regulated and dysregulated infants will experience different developmental pathways from infancy to early childhood, such that well-regulated infants may attend to and interact with their social and physical worlds more, and more effectively, than dysregulated infants, who spend time absorbed in affect regulation (Lewis, 1993a). The latter group may have reduced motivation to explore and participate in their environment. These differences in self-regulation may promote or inhibit the development of competence.

**Infant cognitive performance, attention and emotion regulation**

The first year of life has been identified as a sensitive period wherein organizational systems are believed to develop. Like the attachment system, which is established by twelve months of age and predictive of later social and cognitive outcomes (Lewis et al., 1984), it is possible that an organizational system of self-regulation is also established by twelve months of age. The first year of life may be a critical or sensitive period for the development of a regulatory system that is used by an individual in the selection and engagement of subsequent interactions with the world.

Significant relationships between both attention and emotion regulation with infants' concurrent performance on a standard two location,
"A not B" object permanence task have been found (MacLean, Miller, Keenan & Keating, 1995). Well-regulated infants, in comparison to their dysregulated peers, appeared to be more able to modulate their emotion and focus their attention in the service of a cognitive task. This particular task affords opportunities to examine regulation because it challenges the cognitive system, it requires an infant to engage socially with a stranger, and it may induce stress through the repeated removal of a toy.

A subgroup of infants (N=32) was randomly chosen (from a larger sample of an ongoing longitudinal study examining the development of the object concept) to yield a balanced design for age (9 and 12 months), gender, and search accuracy (correct or incorrect on the first B-trial). Videotapes of the A-not-B task performance were used to rate positive affect, negative affect, and intensity of engagement (using 5-point Likert-type scales) for each 10 second interval of the third (and last) "A" location hiding episode and for the initial 10 seconds of the first "B" location hiding episode (prior to observing whether the infant's search was correct). Interrater agreement on 50% of the coding was r=.75.

A composite positive affect variable was used to assess emotion regulation, and intensity of engagement was used to assess attention regulation. These regulation variables were associated with cognitive performance, as shown in a significant interaction of search accuracy with trial, alone and in combination with subject characteristics such as age and gender. Correct searchers displayed low positive affect at trial "A3" (similar to the disinterest found when using habituation paradigms) and high positive affect at "B1" (due to the novelty of a different hiding location renewing interest), while incorrect searchers showed high positive affect at trial "A3"
(having mastered that task) and low positive affect at trial "B1" (faced with a too-complex challenge).

Overall, these results support the notion that effective emotional and attention regulation is associated with on-line cognitive performance, even in infancy. For both variables, a search accuracy-by-trial interaction was observed, in combination with other variables. The results do not, however, indicate the causal direction. It may well arise from mutual causality in a self-organizing system, as developing competence incorporates emerging regulatory and performance capabilities (MacLean et al., 1995).

We might expect that well-regulated infants will be able to recruit a creative balance of internally and externally oriented behaviours in the service of regulation and consequently, task completion. This approach to the task may also be characterized by positive affect. In contrast, dysregulated infants may not recruit behaviours effectively in the service of regulation and subsequent task completion. Dysregulated infants may approach tasks with abundance of inappropriate internal or external behaviours (for example, withdrawal or active resistance, respectively), negative affect, and/or inadequate task engagement, either initially or over time.

Key questions in this investigation

Based on the theoretical arguments and empirical evidence reviewed above, it is possible to frame three key developmental questions about the relationships between self-regulation and cognitive competence from infancy to early childhood.

1) Does infant self-regulation (attentional, emotional, and social) predict preschool cognitive competence?

2) Does infant self-regulation predict preschool attentional and emotional self-regulation?
3) Does preschool self-regulation predict preschool cognitive competence?

In addition to these basic questions, it will be of interest to explore the degree to which infant and preschool self-regulation make joint or independent contributions to cognitive competence. In order to explore the first two questions, a longitudinal design is required. Infants from the cohort who participated in the MacLean, et al. (1995) study of self-regulation and object permanence performance participated at preschool age (mean age = 5 years, 11 months) in the longitudinal portion of this study. Broad assessments of their cognitive competence and self-regulatory capabilities enabled the exploration of the longitudinal pathways identified in the first two questions, as well as the examination of their concurrent relationships as described in question three. The age range for the Time 2 assessments is particularly important, given the substantial evidence for strong relationships between cognitive performance at school entry and subsequent school and career success (Entwisle & Alexander, 1990; Kellam, Brown, Rubin, & Ensminger, 1983; Morrison, Hardway, Griffith, & Williamson, 1995; Tremblay, Masse, Peron, & Leblanc, 1992).
Method

Subjects

One hundred-and-four children (48 females, mean age = 5 years, 11 months; and 56 males, mean age = 5 years, 11 months) and their parents, who belong to an established subject pool in the Infant Research Laboratory at Brock University, St. Catharines, Ontario were recruited by telephone and asked to participate in the second phase of a study examining normal cognitive development and perspective-taking during early childhood. Four of the 104 subjects who participated in this study (2 females and 2 males) were excluded from the sample. These four children refused to participate in all parts of the study, hence their Time 2 files were incomplete.

The original infant subject pool (N=465) was formed through pediatrician referrals and recruitment letters that were sent to all those who advertised their child's birth in the local papers of the Niagara Region. At Time 1 each infant was tested, at least once, at nine and/or twelve months-of-age in a standard "A not B" object concept hiding task. This task lasted approximately 5 minutes and took place after a 10 minute introduction where a female experimenter became acquainted with each infant and his/her parent. Testing times were arranged to accommodate the infant's feeding and sleeping schedule testing only occurred if the infant was in an optimal testing state. If hungry, the infant was fed and if the infant was judged to be distressed or tired, testing was discontinued.

All infant testing took place within two weeks of the targeted age (9 and 12 months). Of the one-hundred preschoolers in the Time 2 sample, 16 were observed at only 9-months-of-age, 28 were observed at only 12-months-of-age, and 56 were observed at both 9 and 12-months-of-age (Total N of observations in the object permanence task = 156)
Infant Measures

**Self-regulation.** Global measures of attention and emotion regulation were coded from videotapes of infants' participation in the standard "A not B" object permanence paradigm.

**Object permanence task.** This paradigm involves five trials where the infant is encouraged to search for a toy that is first hidden three times in "Hole A" (Trials A1, A2, and A3) and then two times in "Hole B" (Trials B1 and B2). The specific paradigm used varied on the following three dimensions: the number of hiding locations (2 vs. 5); the time delay between hiding and search (0 vs. 5 seconds); and on toy removal (that is, whether the toy was surreptitiously removed by the experimenter on Trials B1 and B2 before the infant began his/her search). See Appendix A for a cross sectional view of the subjects in each of these conditions.

This "A not B" task affords a valuable opportunity to examine the key organizers of attention and emotion regulation for several reasons: it presents a challenging set of demands to the cognitive system; it requires the infant to engage in a moderately intense but positive and game-like social exchange with a stranger; and embedded within this standard task are several episodes likely to induce some distress in most infants (such as removing the toy from the infant after s/he has retrieved it from the hiding location; or parent's restraint of the infant to inhibit premature reaching to the hiding location).

**Attention and emotion regulation.** Seven measures were chosen to reflect a broad but theoretically specific range of concepts thought important to an infant's self-regulatory ability. The measures consist of five point rating scales (1=low; 5=high) and were completed for every 10 second interval for hiding episodes A1, A3, and B1. Trial A1 was selected for coding because it
yields a measure of infants' initial emotional and attentional engagement. Trial A3 yields a measure of infants' sustained engagement and Trial B1 yields an index of infants' engagement at test, when the task is more challenging. The seven scales represent the degree of behaviours reflecting the presence or absence of the following constructs: positive affect (smiling, cooing, laughing); negative affect (crying, fussing, frowning); social referencing (infant's use of other to seek information); social enjoyment (amount of social pleasure that baby experiences from engagement in the game); social attention (infant's degree of interest in objects vs. interest in people); intensity of task engagement (degree of baby's interest and participation in the game); efficacy of co-regulation (ability of parent-infant dyad to function in service of task completion). Two aspects of the last scale should be noted. It is a dyadic rather than an infant variable, in that it assesses how the parent and child interact in the task. Also, this scale does not represent the full range of possible co-regulation between parent and child, in that the instructions to the parent urge them not to become directly involved in the task. None the less, there was a good deal of opportunity for indirect support by parents of such young children, such as helping them to clap hands along with the experimenter during the five-second delay condition. See Appendix B1 for a more detailed coding scheme and Appendix B2 for a coding sheet that was used to assess infant self-regulation.

Interrater agreement. Self-regulation was coded from 72 nine-month-olds and 84 twelve-month-olds by this author. Approximately 20% of the subjects in each group (N = 15 & 16 respectively) were coded by graduate students in an educational or child clinical psychology program trained by the author. Interrater agreement was calculated both as a correlation and as percentage of exact and plus- or minus-one agreement. The data were
calculated for each ten-second segment, for a total of 1643 segments rated independently by two raters. The mean interrater correlation was .73, The mean percentage exact agreement was 52%, and the mean of plus- or minus-one agreement was 35%, yielding a mean percentage agreement within one rating point of 88%. These figures indicate a substantial level of interrater agreement, justifying the use of these ratings in the analyses to follow.

**Early Childhood Measures**

**Self-regulation.** Developmentally appropriate global measures of attention and emotion regulation were coded from videotapes of the Block Design subscale of the Wechsler Primary and Preschool Scale of Intelligence-Revised (WPPSI-R). Four episodes were selected for coding:

1) **Block design task negotiation.** This episode provides an opportunity to assess self-regulation while the child negotiates the social stress of interacting with a novel person in a novel context when he/she is faced with an unknown task. It begins at the end of the comprehension subscale (administered first) and finishes at the end of the first BD demonstration. The episode lasts approximately 90 seconds and measures were taken for each 30 second segment of this episode.

2) **Novelty trial.** This episode yields an opportunity to assess self-regulation during the child's initial reaction to the novel social and cognitive demands of the task. This episode began when the child starts to work on the first Block Design trial. (Trial #1 for children less than five-years and 11 months and Trial #6 for those children older than this). Measures were coded from three segments: the first 30 seconds that the child worked on the design; the period from this point until the design end; and for 30 seconds after design completion.
3) **Peak trial.** This episode yields an opportunity to assess self-regulation when the child's abilities are best matched with the task demands. The trial selected was four trials before the last design that the child attempted. Measures were also coded from three segments: the first 30 seconds that the child worked on the design; the period from this point until the design end; and for 30 seconds after design completion.

4) **Challenge trial.** This episode yields an opportunity to assess self-regulation when the child is still motivated to work on the design. The trial selected was one before the last design that the child attempted. "Giving up" is often observed on the very last trial. Measures were coded from three segments: the first 30 seconds that the child worked on the design; the period from this point until the design end; and for 30 seconds after design completion.

Akin to the "A not B" paradigm, the block design task affords a valuable opportunity to examine the key organizers of attention and emotion regulation. It challenges the cognitive system in that the child is presented with a maximum of 14 block designs to replicate. It requires the child to interact socially with a novel adult; it requires the child attend to the task for at least 10 minutes, to repeat failed attempts, and persist at the task with minimal verbal / physical support from an adult. Also embedded within this standard task are several episodes likely to induce some distress in most preschoolers. The child must follow the social script of the task, that is, the child must attend to the experimenter's instructions and wait until permitted to examine the design, touch the blocks, and begin working on the design. Further, the child cannot work on the design until she/he is finished because each design must be completed within an allotted time.
Eight 5-point rating scales (1=low; 5=high) were used to assess self-regulation on each episode and represent the degree of behaviours reflecting the presence or absence of the following constructs: positive affect (degree of happiness, directed at self or other); negative-anxious affect (degree of anxiety directed at self); negative-angry affect (degree of irritation, resistance, defiance directed at other); intensity of engagement (degree of task involvement); response to perceived error (degree of comfort with perceived performance error); social participation in game script (degree of involvement in the social aspect of the task); sociability (degree of enjoyment in social aspect of the task); efficacy of self-regulation (degree of attentional / emotional control and consequent ability to move between or negotiate the transitions between different parts of the task. See Appendix C1 for a more detailed coding scheme and Appendix C2 for a coding sheet that was used to assess preschool self-regulation.

Interrater agreement. Self-regulation was coded from 100 preschoolers by the author. Eleven per cent of the subjects were coded by a research assistant trained by the author. Interrater agreement was calculated both as a correlation and as percentage of exact and plus- or minus-one agreement. The data were calculated for each thirty-second segment, for a total of 1054 segments rated independently by the two raters. The mean interrater correlation on the first eight subjects was .67. The mean percentage exact agreement was 49%, and the mean of plus- or minus-one agreement was 38%, yielding a mean percentage agreement within one rating point of 87%. Inspection of the specific ratings indicated that there was a systematic discrepancy between the raters on two subscales from the same episode segment. Removing these discrepancies and reanalyzing the agreement yielded a correlation of .78 and agreement within one rating point of 89%. An
additional three subjects were rated following the resolution of this discrepancy, yielding a mean agreement correlation of .83. These figures indicate a substantial level of interrater agreement, justifying the use of these ratings in the analyses to follow.

Cognitive competence. Four subscales of the WPPSI-R (arithmetic; comprehension; block design; picture completion) were used to assess cognitive competence. A formula originally developed by Tellegen and Briggs (1967) was used to determine how reliably these particular four subtests jointly predicted full scale IQ, yielding an estimated reliability of .89 (Atkinson and Yoshida, 1989). A full-scale IQ equivalent was then computed by multiplying the mean of the scaled scores by four and dividing this product by ten. In addition to providing an estimate of the representativeness of this sample on a standardized assessment of intelligence, the use of four subscales was valuable as a counterweight to the necessary confounding of Block Design scores with self-regulation ratings from that task.

Social-Cognitive Competence

Situational / psychological inference task. This task involves two Class One stories (situational inference) and two Class Two stories (psychological inference). For each character in each story the child is asked to identify the character's feeling state and infer why the character is feeling that way. The information necessary to make these inferences is evident in the Class One story because the outcome is objectively different for each of character (they either won or lost a present/toy). The information is not evident in the Class Two stories because the outcome is objectively the same (each character receives a puppy/toy), yet the facial cues of the characters represent different affective states (happy or sad). There are four characters in each class of stories (Mickey and Minnie Mouse / boy and girl) and the boy/girl character's name
was altered to match the subject's name. Stories were scored such that one point was given for each correct discrimination of emotion and one point was given for each correct situational or psychological inference. This task is a slightly modified version of that used by Gove & Keating, 1979 (see Appendix D1 for the task protocol and Appendix D2 for the coding scheme).

Representational vs. constructive theory of mind. A modified version of Chandler and LaLonde's (in press) "Droodle Task" was used to test for a representational vs. constructive theory of mind. This research proposes that a child holds a representational theory of mind when he/she understands that another can hold a different view of the same objective reality. A child is believed to hold a constructive theory of mind when he/she understands that more than one view of reality can be constructed. In this paradigm, each child is introduced to a doll (Raggedy Ann and Andy, matched for target child's gender) and told that while in his/her house, the doll cannot hear or see anything that occurs outside. The doll is put in his/her house and the child is presented with six pictures (individually) and asked to describe each picture. After viewing each picture, a cover is placed over it and the child retrieves the doll from his/her house. The doll is shown a restricted view of the picture (through a small window) and the child is asked to describe the doll's perspective. The child is then reminded of his/her peer and asked to describe his/her friend's perspective (Each subject brought a peer to the laboratory to participate in parts of a study not reported here). The first two pictures assess the child's understanding of false belief (representational theory of mind). The second two assess whether the child is able to generate two views of the same reality. The third set of pictures encourage the child to generate two views of the same reality because the experimenter has told the child that the doll and his/her friend do not think that the picture is the same
thing (Chandler & Lalonde, in press). See Appendix E1 for the task protocol and Appendix E2 for the coding scheme

**Parental Report Measures**

**Self-regulation**

**Reactivity scale.** This 16 item, 7-point scale taps parents' perceptions of the degree to which their child experiences emotions and responds autonomically in regular situations. It was completed by one parent and the items were drawn from Eisenberg et al.'s (1993) scales which were designed to assess preschooler's abilities to regulate their emotions. See Appendix F1 for the Reactivity Scale and items that were reversed when coded.

**Attentional flow scale.** This 23 item, 7-point scale was used to assess a child's attentional shifting and focusing during everyday activities. It was completed by one parent and was drawn from Eisenberg et al.'s (1993) attentional focusing and shifting scale and from Derryberry and Rothbart's (1988) temperament scale. See Appendix F2 for the Attentional Flow Scale and items that were reversed when coded.

**Child behavior checklist (CBCL).** The CBCL is a standardized temperament scale which yields an internalizing score and a externalizing score (Achenbach, 1991). The internalizing score is based on the Withdrawn, Somatic Complaints, and Anxious / Depressed subscales. The externalizing score is based on the Delinquent Behaviour and Aggressive Behaviour subscales.

**Demographic Characteristics / Socioeconomic Status (SES)**

**Parental education and household income.**

Parental education levels and total household income were assessed using relevant sections of the pilot version of the National Longitudinal Survey of Children (NLSC). These scales were converted to standard scores and mean
was taken to yield a global measure of socioeconomic status. See Appendix G1 for the Education Scale and Appendix G2 for the Household Income Scale. The NLSC was given to the parents at the end of the testing session; 84 of the 100 questionnaires were returned.

Procedure

Parents of infants who participated in the original study were contacted and asked to participate with their child and one of his/her friends in a 90 minute session designed to examine normal development in early childhood.

Informed consent was obtained from both parents upon their arrival at the lab and a brief overview of the study was given. As part of the larger study, both children were videotaped during a 15 minute free play session and a five minute clean-up session. Following this, one researcher administered the WPPSI-R to the target child and after this session, both children had a five minute break, a snack and a drink.

Next, the target child completed the Theory of Mind task, built a lego model (alone and then with his/her parent), completed the Inference Task, and then taught his/her friend to build the lego model. At this time, parents completed the Reactivity, Attentional Flow, and CBC-L scales. Both the parents and children were debriefed at the end of each session.

Summary. To review, the following variables assessed at the preschool period were used in this study: standardized cognitive competence, using four subscales of the WPPSI-R, with a particular focus on Block Design; social-cognitive competence, using two standardized tasks from that domain, slightly modified for this investigation (Chandler & Lalonde, in press; Gove & Keating, 1979); parental reports of self-regulation, using a standardized questionnaire (CBC-L, Achenbach, 1991) and an experimental survey drawn
from current work in the field (Eisenberg, 1993; Derryberry & Rothbart, 1988); demographic aspects of the child's household, drawn from the National Longitudinal Survey of Children; and ratings of the children's self-regulatory capabilities, based on direct observations (via videotape) of their behaviour in a challenging cognitive task (i.e., Block Design). Infant measures of self-regulation were based on direct observations (via videotape) of their behaviour in a developmentally appropriate but challenging task in the first year of life, the object permanence task.
Results

Three phases of data analyses are reported in this section. The first section describes the analyses relevant to the reduction of the numerous behavioural ratings into composite variables and the consolidation of child performance and parent report variables. The second phase describes the core analyses relevant to the key developmental questions posed at the end of the introduction. The third and final phase describes the interrelationships of behavioural and parentally reported measures of regulation.

Preliminary Analyses: Data Consolidation and Reduction

Because the core analyses employ correlation and multiple regression, it is important to reduce the number of variables in order to maximize the power of those analyses. In infant regulation, each subject was rated on 63 to 126 variables (7 scales X 3 trials X 3 to 6 ten-second segments. In preschool regulation, each subject was rated on 64 to 96 variables (8 scales X 4 episodes X 2 to 3 segments).

Each set of regulation variables (infant and preschool) were analyzed using factor analyses and theoretical considerations. Construction of the composite variables was carried out prior to and independent of examination of their relations to each other or to the cognitive performance or parent report variables.

Infant regulation. The first step in this analysis was to check for possible effects of age, gender, and experimental condition on the behavioural ratings. A series of analyses of variance (ANOVA's) combining age with conditions and gender with conditions for all ratings were conducted. Of 1707 possible contrasts (including main effects and interactions), 71 (4.2%) were significant at p<.05. This is almost exactly what would be expected by
chance; moreover, inspection of the obtained effects showed no systematic patterns. Based on these findings and for the purposes of data reduction and construction of composite variables, ratings were factor analyzed across subject characteristics and experimental conditions.

To increase the core sample size, and hence the power of the subsequent multiple regressions, the infant regulation variables were consolidated across age. For subjects who participated only at 9-months (N=16) or 12-months (N=28), an age-standardized Z-score for each variable was assigned. For subjects who participated at both 9- and 12-months (N=56), the mean of the two age-standardized Z-scores was calculated for each variable. Thus, each of the 100 subjects in the longitudinal study had a single standardized score for each infant regulation rating.

Upon inspection of the resulting data array, it was apparent that data were available for all subjects in the first three ten-second segments of each rating scale. To avoid the complications of missing data, and given that online observation suggested that much of the interesting variance was concentrated in the first thirty seconds of each trial, ratings from these segments were used in the factor analyses.

Finally, a combination of factor analytic patterns and theoretically guided considerations were used to arrive at the final infant regulation composite variables. Details of the factor analyses are reported in Appendix H. The general strategy, given the large number of variables relative to sample size, was first to group the variables by type of regulation (attentional, emotional, and social) for separate factor analyses. Resulting factor structures were used as a guide to constructing the composite variables. Composite variables were constructed from equal weightings of the identified standardized variables, rather than using factor scores, which would likely be
less stable given the low subject-to-variable ratio obtained even after grouping by type (in the range of 4:1 or 5:1, rather than the 20:1 or 10:1 ratios generally recommended for stable factor structures -- Stevens, 1986). The least transformed factor structure yielding reasonable resolution was preferred, specifically principal components (unrotated factor structures) over orthogonal transformation with varimax, and orthogonal over oblique solutions. In fact, oblique solutions were not required in any of the analyses to obtain a theoretically coherent composite. The composite variables for infant regulation, and the formulae used to derive them, are shown in Table 1.

Insert Table 1 about here

Preschool regulation. As stated, preschool regulation was rated on 64 to 96 variables (8 scales X 4 episodes X 2 to 3 segments). Upon inspection of the resulting preschool data array, it was apparent that data were available for all subjects in the first thirty-second segment of each episode. Most children completed at least two of the 3 block designs within the first 30 second segment. To avoid the complications of missing data, and given that on-line observation suggested that much of the interesting variance was concentrated in the first thirty seconds of each episode, rather than the 30 seconds post trial, ratings from the first segment were used in the factor analyses.

Finally, a combination of factor analytic patterns and theoretically guided considerations were used to arrive at the final preschool regulation composite variables. Details of the factor analyses are reported in Appendix I. Again, the general strategy, given the large number of variables relative to sample size, was first to group the variables by type of regulation (attentional,
Table 1

Composite Variables of Infant Regulation

<table>
<thead>
<tr>
<th>Composite Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect</td>
<td></td>
</tr>
<tr>
<td>IE:A1</td>
<td></td>
</tr>
<tr>
<td>(IE:A3)+(IE:B1)</td>
<td></td>
</tr>
<tr>
<td>Social Monitoring</td>
<td></td>
</tr>
<tr>
<td>Social Enjoyment</td>
<td></td>
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<tr>
<td>Social Enjoyment</td>
<td></td>
</tr>
<tr>
<td>Efficacy of Co-regulation*</td>
<td></td>
</tr>
<tr>
<td>*(PA:A1)+(PA:A3)+(PA:B1)</td>
<td></td>
</tr>
<tr>
<td>(EC:A1)+(EC:A3)+(EC:B1)</td>
<td></td>
</tr>
</tbody>
</table>

Note: A1=Trial A1; A3=Trial A3; B1=Trial B1  
PA=Positive Affect; NA=Negative Affect; IE=Intensity of Engagement; 
SR=Social Referencing; SA=Social Attention; 
EC=Efficacy of Co-regulation  
*Dyadic variable, focusing on ratings of parent-child interaction.
emotional, and social) for separate factor analyses. Resulting factor structures were used as a guide to constructing the composite variables. Composite variables were constructed from equal weightings of the identified standardized variables, rather than using factor scores. Although the factor structures might be borderline stability, given the subject to variable ratio of 8:1 to 12:1, it seemed likely that the equally weighted composite variables would retain a greater proportion of the originally observed behavioural variability.

The least transformed factor structure yielding reasonable resolution was preferred, specifically principal components (unrotated factor structures) over orthogonal transformation with varimax, and orthogonal over oblique solutions. Akin to the infant regulation factor analyses, oblique solutions were not required in any of the analyses to obtain a theoretically coherent composite. The composite variables for preschool regulation, and the formulae used to derive them, are shown in Table 2.

Cognitive competence composites. To simplify the analyses, composite variables were constructed for performance and parent report measures. Standardized scores for the two social-cognitive tasks were summed to create a Social Cognitive Composite. Full scale IQ-equivalents were converted Z-scores, and a mean of this and the Social Cognitive Composite was calculated as an overall Cognitive Competence Composite. The target problem-solving task for the preschoolers, Block Design, was not
Table 2

Composite Variables of Preschool Regulation

<table>
<thead>
<tr>
<th>Composite Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect -Novel</td>
<td>([(PA:\text{TN})+(PA:\text{NT})-(NAA:\text{TN})-(NAA:\text{NT})])</td>
</tr>
<tr>
<td>Positive Affect -Challenge</td>
<td>((PA:\text{CT}) - (NAA:\text{CT}))</td>
</tr>
<tr>
<td>Anger</td>
<td>((NAG:\text{TN})+(NAG:\text{NT})+(NAG:\text{PT})+(NAG:\text{CT})/4)</td>
</tr>
<tr>
<td>Attention -General</td>
<td>((\text{IE:TN})+(\text{IE:NT})+(\text{ESR:TN})+(\text{ESR:NT}) +(\text{ESR:PT})/5)</td>
</tr>
<tr>
<td>Attention -Challenge</td>
<td>((\text{IE:CT})+(\text{RPE:CT})+(\text{ESR:CT})/3)</td>
</tr>
<tr>
<td>Social-Novel</td>
<td>((\text{SPGS:TN})+(\text{SPGS:NT})+(\text{S:TN})+(\text{S:NT})/4)</td>
</tr>
<tr>
<td>Social-Peak /Challenge</td>
<td>((\text{SPGS:PT})+(\text{SPGS:CT})+(\text{S:PT})+(\text{S:CT})/4)</td>
</tr>
</tbody>
</table>

Note: PA=Positive Affect; NAA=Negative-Anxious Affect; NAG=Negative-Angry Affect; IE=Intensity of Engagement; ESR=Efficacy of Self-Regulation; RPE=Response to Perceived Error; SPGS=Social Participation in Game Script; S=Sociability

TN=Task Negotiation; NT=Novelty Trial; PT=Peak Trial; CT=Challenge Trial
transformed; the scale score from the WPPSI-R manual was used in this instance.

Means and standard deviations of the cognitive and parent report variables are shown in Table 3, for the full sample and for boys and girls separately. Only one significant gender difference was found for these variables, with parents reporting more externalizing behaviours for boys than for girls, which is consistent with published norms for this scale (Achenbach, 1991).

Insert Table 3 about here

Core Analyses of the Key Developmental Questions

In this section, analyses are grouped with respect to the key developmental questions posed at the end of the introduction. For each question, both correlational analyses and multiple regressions are reported.

Question 1: Does infant self-regulation (attentional and emotional) predict preschool cognitive competence?

The first step in addressing this question is to examine the intercorrelations of the relevant composite variables. The correlation matrix is shown in Table 4.

Insert Table 4 about here

With respect to the key cognitive problem-solving task, there are several significant positive correlations between infant regulation composite variables and Block Design at \( p < .05 \): Positive Affect \( r = .25 \), Sustained Engagement \( r = .20 \), and Social Enjoyment \( r = .19 \). In addition, Initial
Table 3

Means and Standard Deviations of Cognitive and Social-Cognitive Measures, Parental Reports of Child Regulation, and Parental SES

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (n)</th>
<th>Male (n)</th>
<th>Female (n)</th>
<th>All (n)</th>
<th>Male (n)</th>
<th>Female (n)</th>
<th>All (n)</th>
<th>Range</th>
</tr>
</thead>
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<tr>
<td>Full Scale IQ Equivalent</td>
<td>116.21  (100)</td>
<td>117.81  (54)</td>
<td>114.33  (46)</td>
<td>18.13</td>
<td>16.95</td>
<td>19.45</td>
<td>75-155</td>
<td>87.5-155</td>
</tr>
<tr>
<td>Block Design Scaled Score</td>
<td>2.18  (100)</td>
<td>2.13  (54)</td>
<td>2.24  (46)</td>
<td>5-17</td>
<td>5-17</td>
<td>7-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situational Inference Score</td>
<td>0.5  (96)</td>
<td>0.61  (52)</td>
<td>0.302  (44)</td>
<td>1-4</td>
<td>1-4</td>
<td>2-4</td>
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<td></td>
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<tr>
<td>Psychological Inference Score</td>
<td>1.47  (52)</td>
<td>1.55  (44)</td>
<td>1.37</td>
<td>0-6</td>
<td>0-6</td>
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<tr>
<td>False Belief Score</td>
<td>5.5  (100)</td>
<td>5.29  (54)</td>
<td>5.67</td>
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<tr>
<td>Interpretive Theory of Mind Score</td>
<td>2.63  (100)</td>
<td>2.69  (54)</td>
<td>2.57  (46)</td>
<td>1.3</td>
<td>1.32</td>
<td>1.28</td>
<td>0-6</td>
<td>0-6</td>
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<tr>
<td>CBC-L Internalizing Score</td>
<td>6.28  (100)</td>
<td>6.22  (54)</td>
<td>6.35  (46)</td>
<td>6.15</td>
<td>6.9</td>
<td>5.21</td>
<td>0-28</td>
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<tr>
<td>CBC-L Externalizing Score*</td>
<td>9.19  (100)</td>
<td>10.32  (54)</td>
<td>7.87  (46)</td>
<td>7.55</td>
<td>8.49</td>
<td>6.10</td>
<td>0-41</td>
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<tr>
<td>Reactivity Scale Mean</td>
<td>3.73  (96)</td>
<td>3.76  (53)</td>
<td>3.69  (43)</td>
<td>.76</td>
<td>.76</td>
<td>.77</td>
<td>2.06-5.63</td>
<td>2.06-5.06</td>
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<tr>
<td>Attentional Flow Scale Mean</td>
<td>4.58  (96)</td>
<td>4.54  (53)</td>
<td>4.64  (43)</td>
<td>.56</td>
<td>.55</td>
<td>.57</td>
<td>3.14-6.18</td>
<td>3.14-6.18</td>
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<td>Mean Parental Education</td>
<td>6.58  (84)</td>
<td>6.41  (48)</td>
<td>6.82  (36)</td>
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<td>1.32</td>
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<tr>
<td>Household Income</td>
<td>11.53  (76)</td>
<td>12  (43)</td>
<td>10.91  (33)</td>
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<td>5.11</td>
<td>4.51</td>
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*p < .05, Males > Females
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<td>1. Positive Affect</td>
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<td></td>
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<tr>
<td>2. Initial Engagement</td>
<td></td>
<td>.434**</td>
<td></td>
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<tr>
<td>3. Sustained Engagement</td>
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<td></td>
<td>.488**</td>
<td>.542**</td>
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<tr>
<td>4. Social Monitoring</td>
<td></td>
<td>-0.041</td>
<td>-0.167+</td>
<td>-0.053</td>
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<td>5. Social Enjoyment</td>
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<td></td>
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<td></td>
<td>.719**</td>
<td>.374**</td>
<td>.41**</td>
<td>.186+</td>
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<td>6. Efficacy of Co-Regulation</td>
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<td></td>
<td></td>
<td>.307**</td>
<td>.068</td>
<td>.138</td>
<td>.176+</td>
<td>.254**</td>
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<td>7. Block Design</td>
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<td>.245*</td>
<td>.174+</td>
<td>.203*</td>
<td>-0.144</td>
<td>.192*</td>
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<td>8. Inference Sum Z</td>
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<td>.069</td>
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<td>-0.159</td>
<td>0.013</td>
<td>0.022</td>
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<td>9. Theory of Mind Sum</td>
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<td></td>
<td></td>
<td>.079</td>
<td>.059</td>
<td>-0.078</td>
<td>-0.227*</td>
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<td>10. Social Cognitive Composite</td>
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<td></td>
<td></td>
<td></td>
<td>.134</td>
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<td>-0.082</td>
</tr>
<tr>
<td>11. Cognitive Composite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.163+</td>
<td>.043</td>
</tr>
</tbody>
</table>

*p<.10, *p<.05, **p<.01

Note: Social Cognitive Composite=Inference and Theory of Mind Task Z-scores; Cognitive Competence Composite=Social Cognitive Composite and Full Scale IQ equivalent Z-score. (See Appendix I for details on construction of Infant Regulation Composite Variables.)
Engagement yielded a marginally significant trend in the same direction (r=.19, p < .10). Thus, the infant emotional and attentional regulation composite variables showed moderate to robust relationships with performance on a challenging cognitive task completed 4 to 5 years later. Only Social Monitoring yielded a negative, though non-significant correlation with Block Design (r= -.14). It is also the only variable that has a negative implication for regulation, in that it captures in part the degree to which the infant "inappropriately" focused on the experimenter rather than on the task during the object permanence situation. The only dyadic variable, Efficacy of Co-regulation, had a low and non-significant correlation with Block Design (r=.08), due perhaps to the constraints placed on parent-child interaction imposed during the object permanence task.

In contrast, none of the infant regulation composite variables yielded significant correlations with the Social Cognitive Composite. Note, however, that the correlations for Positive Affect and Social Monitoring were significantly different from each other, and in the same directions found for Block Design.

For the Cognitive Competence Composite (which included the Social Cognitive Composite and the IQ-equivalent), only Social Monitoring yielded a correlation that was even marginally significant (r= -.18, p < .10). Again, this was negatively related to competence, and was significantly different from Positive Affect (r=.14).

Taken together, these findings offer evidence for a relationship between infant regulation and the cognitive competence of preschoolers. This was especially true for Block Design, which was the focal cognitive task because of its structural similarity to the object permanence task noted
above. In addition, the consistently negative direction of Social Monitoring, both absolutely and relative to the other regulation composites, supports an interpretation of that variable as indexing a level of social attending and referencing that may impede attention to more object-oriented task demands.

It seems likely on the basis of theoretical analysis that these aspects of self-regulation do not operate independently of each other (Keating, in press). Indeed, as shown in Table 4, there are a number of substantial intercorrelations among the regulation composite variables. Excluding the dyadic variable (Efficacy of Co-regulation), all the regulation composite variables are positively and significantly ($p < .01$) related to each other, again with the exception of Social Monitoring. This variable is marginally negatively related to Initial Engagement ($r = -.16$) and positively related to Social Enjoyment (both $p < .10$, significantly different from each other, $p < .05$). This pattern affords a potential clarification of the Social Monitoring variable, in that it may capture a positive feature, the enjoyment of social interaction for its own sake, and a negative feature, an overfocusing on the social situation (such as looking for help from the experimenter, or worry about the experimenter's intentions) to the detriment of task engagement.

Correlational analyses, however, are limited in that they capture only bi-directional associations. Multiple regressions are capable of capturing the multivariate features of these interrelations. Because the goal was to observe any substantial pattern of relations across the several years between Time 1 and Time 2, a simultaneous regression strategy was selected. In addition, to reduce the possibility of Type II (or beta) error, an alpha value of .10 was selected as a cutoff for interpretation. A second set of regressions examined the contribution of infant regulation to preschool competence independent of preschool regulation, by predicting the residuals after regressing preschool
cognitive competence on preschool regulation. Following the main regression analyses, stepwise regression was employed to check for possible confounding variables in the interpretation, by forcing SES and child's age as first steps in the equations. The overall picture from these regressions is quite straightforward and consistent with the correlational analyses. The findings for each cognitive variable are shown in Table 5.

```
Insert Table 5 about here
```

The infant regulation composite variables significantly predicted the Cognitive Competence Composite, $R=.33$, $p<.05$. Significant specific predictors were Positive Affect and Sustained Engagement. Interestingly, these coefficients are in the opposite direction, even though these two predictors are positively correlated with each other. This may arise from the fact that Sustained Engagement captures two aspects of infant performance: the ability to remain task-focused; and an habituation effect for the most successful infants, for whom the last "same-hole" trial in object permanence (trial A3) may be too repetitive (that is, easy) to engage their attention. This interpretation is consistent with the relationship between infant regulation and concurrent object permanence performance reported by MacLean et al. (1995).

For the focal task of Block Design, the multiple correlation is similar in magnitude to that obtained for the Cognitive Competence Composite, $R=.30$, but is not significant at $p<.10$. Note, however, that for this criterion, 4 of the zero-order correlations were significant at $p<.10$ or less. It seems likely that the collinearity of the predictors, and the total number of predictors, carried the multiple regression above the specified alpha level.
Table 5

Preschool Cognitive Performance Predicted by Infant Regulation Variables, Simultaneous Multiple Regressions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cognitive Competence Composite</th>
<th>Block Design</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.33*</td>
<td>.30</td>
<td>.36*</td>
</tr>
<tr>
<td></td>
<td>(.32+)</td>
<td>(.21)</td>
<td>(.32+)</td>
</tr>
<tr>
<td>(Residual)(^a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Squared</td>
<td>.11</td>
<td>.09</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>(.10)</td>
<td>(.05)</td>
<td>(.10)</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

 Predictor Coefficients

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Cognitive Competence Composite</th>
<th>Block Design</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Positive Affect</td>
<td>1.13*</td>
<td>.26</td>
<td>.89**</td>
</tr>
<tr>
<td></td>
<td>(.25+)</td>
<td>(.08)</td>
<td>(.30*)</td>
</tr>
<tr>
<td>2. Initial Engagement</td>
<td>.25</td>
<td>.06</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>(.13)</td>
<td>(-.02)</td>
<td>(.13)</td>
</tr>
<tr>
<td>3. Sustained Engagement</td>
<td>-.109+</td>
<td>.30</td>
<td>-.94*</td>
</tr>
<tr>
<td></td>
<td>(-.39)*</td>
<td>(.01)</td>
<td>(-.38*)</td>
</tr>
<tr>
<td>4. Social Monitoring</td>
<td>-1.02</td>
<td>-.81</td>
<td>-.60</td>
</tr>
<tr>
<td></td>
<td>(-.40)</td>
<td>(-.28)</td>
<td>(-.28)</td>
</tr>
<tr>
<td>5. Social Enjoyment</td>
<td>-1.42</td>
<td>.33</td>
<td>-1.42*</td>
</tr>
<tr>
<td></td>
<td>(-.25)</td>
<td>(.24)</td>
<td>(-.42)</td>
</tr>
</tbody>
</table>

\(+p<.10, \,*p<.05, \,**p<.01\)

Note: Social Cognitive Composite=Inference and Theory of Mind Task Z-scores; Cognitive Competence Composite=Social Cognitive Composite and Full Scale IQ equivalent Z-score

\(^a\) Prediction of residuals after removing the effect of preschool regulation are shown in ().
On the Social Cognitive Composite, $R=.36$, significant at $p<.05$.

Significant specific predictors included Positive Affect (a positive coefficient), Sustained Engagement and Social Enjoyment (both negative coefficients). A similar interpretation for Sustained Engagement to that for the Cognitive Competence Composite seems appropriate. For Social Enjoyment, it is likely that those infants who score high on this measure prefer intensely engaging social interactions. As preschoolers, they may be extroverted and may be socially expressive rather than interpersonally perceptive.

When residuals from the regression of the cognitive variables on preschool regulation are used as the criteria, the overall pattern for the multiple correlations and the beta coefficients are generally unchanged. This suggests that the contribution of the infant regulation composites is largely independent of preschool regulation, that is, a direct effect.

Following these analyses, stepwise regressions were employed to check for possible confounding variables in the interpretation, by forcing SES and child's age as first steps in the equations. When SES was forced into the equation first, no substantial changes in the pattern of regressions were found in the multiple R's predicting Social Cognitive Competence and Cognitive Competence. With SES forced into the regression first, the multiple R predicting Block Design increased by .06; sustained engagement became a marginally significant predictor at $p<.10$. Similarly, the overall pattern of regressions predicting Social Cognitive Competence and Cognitive competence from the infant regulation variables did not change significantly when child's preschool age was forced into the regression first. As well, when one outlier score (a full scale IQ equivalent of 75) was excluded from the analysis, the pattern of regressions predicting Block Design, Social Cognitive Competence, and Cognitive Competence did not change.
Question 2: Does infant self-regulation predict preschool attentional and emotional self-regulation?

The first step in addressing this question is to examine the intercorrelations of the relevant composite variables. The correlation matrix is shown in Table 6.

Insert Table 6 about here

With respect to the preschool attention composite variables (Attention General and Attention Challenge), six of twelve correlations with the infant regulation composite variables are significant at p<.05. All are positive with the exception, again, of Social Monitoring (r= -.27), which is negatively correlated with preschool Attention General. All remaining correlations with the two attention regulation preschool composites are in the expected directions, although non-significant.

On the emotion regulation preschool composites of Positive Affect, weaker correlations were observed. Four of twelve correlations were marginally significant (p<.10), but all correlations were again in the expected direction, including that between Social Monitoring in infancy and Positive Affect Novel in preschool (r= -.18, p<.10). For the preschool composite of Anger, no significant correlations were observed. It may be that anger in social situations with adults unknown to the child is unlikely to occur in infancy, and thus may not yield observable longitudinal continuity.

On the social variables in preschool, the directional pattern found for attention and emotion regulation is maintained, with four correlations at
Table 6

Correlation Matrix of Infant and Preschool Regulation Composite Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Anger</th>
<th>Social-Novel</th>
<th>Social-Peak-Challenge</th>
<th>Attention Challenge</th>
<th>Attention General</th>
<th>Positive Affect-Novel</th>
<th>Positive Affect-Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect</td>
<td>-0.01</td>
<td>0.221*</td>
<td>0.202*</td>
<td>0.085</td>
<td>0.204*</td>
<td>0.168+</td>
<td>0.128</td>
</tr>
<tr>
<td>Initial Engagement</td>
<td>0.141</td>
<td>0.122</td>
<td>0.188+</td>
<td>0.193*</td>
<td>0.197*</td>
<td>0.155</td>
<td>0.107</td>
</tr>
<tr>
<td>Sustained Engagement</td>
<td>0.093</td>
<td>0.19*</td>
<td>0.132</td>
<td>0.241*</td>
<td>0.239*</td>
<td>0.186+</td>
<td>0.184+</td>
</tr>
<tr>
<td>Social Monitoring</td>
<td>-0.043</td>
<td>-0.198*</td>
<td>-0.149</td>
<td>-0.021</td>
<td>-0.272**</td>
<td>-0.177+</td>
<td>-0.073</td>
</tr>
<tr>
<td>Social Enjoyment</td>
<td>0.151</td>
<td>0.093</td>
<td>0.059</td>
<td>0.021</td>
<td>0.026</td>
<td>0.073</td>
<td>0.054</td>
</tr>
<tr>
<td>Efficacy of Co-regulation</td>
<td>-0.008</td>
<td>-0.037</td>
<td>0.001</td>
<td>0.128</td>
<td>0.072</td>
<td>-0.061</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*p<.10, *p<.05, **p<.01
p<.05 (including Social Monitoring correlating negatively with Social Novel, 
r= -.20), and an additional correlation at p<.10 (Initial Engagement with Social 
Peak/ Challenge.

To summarize, the correlational patterns suggest moderately robust 
relationships between infant and preschool regulation from the behavioural 
observations. This is a substantial degree of relationship across a several year 
time span, between relatively brief behavioural episodes.

Preschool regulation composite variables appear to be theoretically 
similar to the set of infant regulation composite variables. Hence, a more 
stringent test is to predict the later composite variables from the earlier set of 
similar regulation variables. Thus, the multiple regressions grouped the 
predictors with the relevant criteria. Specific groupings were as follows: 
Anger (preschool) with Positive Affect and Social Enjoyment (infancy), 
because they index the inverse emotional states from anger; Positive Affect/ 
Novel and Challenge (preschool) with Positive Affect and Social Monitoring 
(infancy), because the latter predictor appears to have captured in part a social 
xiety aspect of infant emotion; Attention/ General and Challenge 
(preschool) with Initial and Sustained Engagement; and Social/ Novel and 
Challenge with Social Monitoring and Social Enjoyment. An additional 
advantage of this strategy is that the power of the multiple regression analyses 
is enhanced by increasing the subject to predictor variable ratio. The results of 
these regression analyses are shown in table 7.

-----------------------------------------------------------------

Insert Table 7 about here

-----------------------------------------------------------------

Six of the seven multiple regressions, theoretically defined in this way, 
were significant at p<.10; four of these six were significant at p<.05. Many of
Table 7

Preschool Regulation Predicted by Selected Infant Regulation Variables, Simultaneous Multiple Regression

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Anger</th>
<th>Social-Novel</th>
<th>Social-Peak / Challenge</th>
<th>Attention Challenge</th>
<th>Attention General</th>
<th>Positive Affect - Novel</th>
<th>Positive Affect - Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.23+</td>
<td>.29*</td>
<td>.26+</td>
<td>.25*</td>
<td>.25*</td>
<td>.24*</td>
<td>.14</td>
</tr>
<tr>
<td>R Squared</td>
<td>.05</td>
<td>.09</td>
<td>.07</td>
<td>.06</td>
<td>.06</td>
<td>.06</td>
<td>.02</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Coefficients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect</td>
<td>-.22+</td>
<td>.21+</td>
<td>.22*</td>
<td>-</td>
<td>-</td>
<td>.44+</td>
<td>.20</td>
</tr>
<tr>
<td>Initial Engagement</td>
<td>-a</td>
<td>-</td>
<td>-</td>
<td>.12</td>
<td>.11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sustained Engagement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.26+</td>
<td>.23+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Social Monitoring</td>
<td>-</td>
<td>-.38+</td>
<td>-.22</td>
<td>-</td>
<td>-</td>
<td>-1.32+</td>
<td>-.30</td>
</tr>
<tr>
<td>Social Enjoyment</td>
<td>.62*</td>
<td>-.12</td>
<td>-.22</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Efficacy of Co-regulation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+p<.10, *p<.05

a Indicates variable not selected for analyses
the specific relationships were as expected: preschool Anger is negatively predicted by infant Positive Affect. Two outliers on preschool Anger were noted in the scatterplot (both above Z=5). To reduce the possible distortion arising from these outliers, each was arbitrarily assigned a score of Z=2.5. The regression pattern did not change when these two outlier scores on the Anger scale were replaced with scores closer to the scale mean. Additionally, a specific individual social predictor of the preschool composite variable Anger was infant Social Enjoyment, but in a positive direction. Again, the babies with high Social Enjoyment scores may be infants who prefer intensely engaging social interactions and may become more extroverted and socially expressive preschoolers. Such children might display anger during the Block Design task because they dislike the problem- or task-focused constraints of the situation.

Preschool Positive Affect-Novel is positively predicted by infant Positive Affect, and negatively by Social Monitoring. This replicates the patterns of findings on Social Monitoring found in the Question 1 analyses, reinforcing its interpretation as tapping a possible "wariness" factor. Positive Affect Challenge was the only preschool regulation composite not significantly predicted by the infant regulation composites. These findings suggest that a baby's emotional response to a novel and demanding task is relatively stable, even over a four to five year period.

The preschool attention regulation composite variables Attention General (R=.25, p<.05) and Attention Challenge (R=.25, p<.05) were significantly and positively predicted by infant attention regulation; the predictability was carried by the variable Sustained Engagement.

The preschool variables Social-Novel (R=.29, p<.05) and Social-Peak/Challenge (R=.26, p<.10) were significantly predicted by the infant
regulation variables. Infant Positive Affect is a significant and positive predictor of both these preschool variables, while infant Social Monitoring negatively predicts the preschool Social Novel composite. The direction of this coefficient is consistent with the previous regressions and again, this infant composite variable is likely capturing, in part, the degree to which the infant "inappropriately" focused on the experimenter rather than on the task. This over-focus on the experimenter may be the infant's attempt to cope with the anxiety of the novel testing situation. As preschoolers, this group may have experienced anxious arousal in the Block Design testing situation which prevented them from engaging socially and positively with the experimenter.

The overall pattern of the multiple regressions supports an interpretation of consistency between infant and preschool regulatory styles, across several different domains of self-regulation. This pattern is further reinforced by the effectiveness of theoretically selected predictors of Time 2 regulation, rather than any possible combination of infant regulation predictors.

Question 3: Does preschool self-regulation predict preschool cognitive competence?

Once again, we begin the exploration of this question with an examination of the correlation matrix. Note, however, that these relationships are concurrent rather than longitudinal. Note also that there is a built-in confound with the Block Design variable, in that it was the task from which the preschool regulation variables were coded. This necessary confounding is counterbalanced in reference to the Social Cognitive Composite, which is not confounded, and to some extent by the Cognitive Competence Composite, which combines the Social Cognitive Composite and
As might be expected given the confound just noted, six of the seven preschool regulation variables (excluding Anger) were significantly correlated (p<.05) with Block Design. Two of seven correlations between preschool regulation and the Social Cognitive Composite were significant (Anger and Social/Peak & Challenge, p<.05). The same two variables were significantly correlated with the Cognitive Competence Composite, plus there was a marginally significant association with Positive Affect/Challenge. These findings suggest a moderately substantial relationship between preschool regulation and preschool cognitive performance, although surprisingly these concurrent correlations were not notably stronger than the longitudinal predictions from infant regulation.

As noted above for the infant regulation variables, it seems likely, on the basis of theoretical analysis, that these aspects of preschool self-regulation do not operate independently of each other. As shown in Table 8, there are a number of substantial intercorrelations among the regulation composite variables. Of the 6 regulation variables with positive valence (excluding anger), 11 of the 15 intercorrelations are significant at p<.05, and 8 of the 11 are significant at p<.01. Two preschool regulation variables are significantly (p<.05) correlated with Anger: Social Peak/Challenge (r= -.22); and Attention General (r=.21). The negative association affords a straightforward interpretation, but the positive association of Attention General with Anger is somewhat puzzling. If replicable, it may be that the component variable of
Table 8

Correlation Matrix of Preschool Regulation Composite Variables, Cognitive, and Social Cognitive Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anger</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Social Novel</td>
<td>.021</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Social-Peak / Challenge</td>
<td>-.223*</td>
<td>.402**</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Attention Challenge</td>
<td>.01</td>
<td>-.113</td>
<td>.245*</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Attention General</td>
<td>.209*</td>
<td>.691**</td>
<td>.349**</td>
<td>.2</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Positive Affect-Novel</td>
<td>.159</td>
<td>.765**</td>
<td>.294*</td>
<td>-.114</td>
<td>.689**</td>
<td>---</td>
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</tr>
<tr>
<td>7. Positive Affect-Challenge</td>
<td>.081</td>
<td>.148</td>
<td>.326**</td>
<td>.405**</td>
<td>.346**</td>
<td>.211*</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. BD</td>
<td>.035</td>
<td>.336**</td>
<td>.247*</td>
<td>.233*</td>
<td>.276**</td>
<td>.356**</td>
<td>.299*</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Inference Sum Z-score</td>
<td>-.458**</td>
<td>.114</td>
<td>.239*</td>
<td>.047</td>
<td>-.079</td>
<td>.02</td>
<td>.188+</td>
<td>-.038</td>
<td>---</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>10. T.O.M. Sum Z-score</td>
<td>-.233*</td>
<td>.067</td>
<td>.334**</td>
<td>.137</td>
<td>.012</td>
<td>.057</td>
<td>.001</td>
<td>.05</td>
<td>.144</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Soc-Cog Composite</td>
<td>-.416**</td>
<td>.069</td>
<td>.364**</td>
<td>.087</td>
<td>-.071</td>
<td>.036</td>
<td>.113</td>
<td>-.05</td>
<td>.68**</td>
<td>.784**</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>12. Cognitive Composite</td>
<td>-.441**</td>
<td>.107</td>
<td>.413**</td>
<td>.131</td>
<td>-.052</td>
<td>.043</td>
<td>.171+</td>
<td>.107</td>
<td>.643**</td>
<td>.751**</td>
<td>.957**</td>
<td>---</td>
</tr>
</tbody>
</table>

Note: See Appendix I for details on construction of preschool regulation composite variables.

+p<.10, *p<.05, **p<.01
Intensity of Engagement during task negotiation (see formula for Attention General in Table 2) may contribute substantially to this finding, but even this fails to clarify the anomaly fully.

The cognitive performance variables were regressed on the preschool regulation variables in the next stage of the analysis. Again, a simultaneous regression strategy was employed, and again regressions on the cognitive performance residuals (after removing the effect of infant regulation variables) are also reported. These regressions are shown in Table 9.

As can be seen in Table 9, all three cognitive composites are significantly (p<.05) predicted by the set of preschool regulation variables. Interestingly, Block Design had no individual beta coefficients that were significant, perhaps due to their roughly equal portions of variance accounted for by each of them on this criterion. On the Social Cognitive Composite, which had an R=.38 (coincidentally identical to the confounded Block Design R), two individual predictors were significant: Anger (negatively) and Positive Affect/Challenge (positively). This is easily interpretable, in that anger is likely to reduce the opportunity for interpersonal perspicacity, whereas positive affect under challenging situations may be associated with the ability to do effective cognitive processing even under demanding social circumstances. For the Cognitive Competence Composite, the overall R=.41 (p<.05), with the same two significant individual predictors as for the Social Cognitive Composite, likely for similar reasons.

As can be seen in Table 9, when the criteria were residuals of the cognitive variables (after regressing infant regulation on them), the overall
Table 9

Preschool Cognitive Competence Predicted by Preschool Regulation Variables, Simultaneous Multiple Regressions

<table>
<thead>
<tr>
<th>Predictor &amp; Coefficients</th>
<th>Cognitive Competence Composite</th>
<th>Block Design</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>R (Residual)(^a)</td>
<td>.41* (.40*)</td>
<td>.38* (.32)</td>
<td>.38* (.36+)</td>
</tr>
<tr>
<td>R Squared</td>
<td>.16 (.16)</td>
<td>.15 (.10)</td>
<td>.14 (.13)</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

1. Anger
   | -.84* (-.23*)                | .13 (.02)     | -.80* (.22*)             |

2. Social Novel
   | .29 (.10)                    | .22 (.06)     | .07 (.04)                |

3. Social Peak / Challenge
   | .43 (.08)                    | .18 (.04)     | .37 (.07)                |

4. Attention General
   | -.47 (-.27)                  | -.03 (-.07)   | -.45 (-.28)              |

5. Attention Challenge
   | -.01 (.07)                   | .44 (.20)     | -.15 (.02)               |

6. Positive Affect Novel
   | -.05 (-.01)                  | .10 (.05)     | -.01 (-.01)              |

7. Positive Affect Challenge
   | .49* (.16*)                  | .13 (.06)     | .43* (.15*)              |

\(^+\)p<.10, \(^*\)p<.05

\(^a\) Prediction of residuals after removing the effect of infant regulation are shown in ( ).
pattern remains virtually identical. Although the Block Design multiple correlation falls below the level of statistical significance, it is in fact not much reduced in magnitude (R=.32 vs .38). Combining these analyses with the regressions using the infant regulation variables, we can conclude that the contributions of the Time 1 and Time 2 regulation variables to differences in cognitive performance are largely independent of each other, in both directions.

The two potentially confounding variables of age and parental SES were checked by forcing them as the first entered variables in stepwise multiple regressions. The previously observed relationships between the regulation variables and performance were maintained in all cases. The only substantial additional variance occurs in the contribution of SES to Block Design, where it adds an additional 9% of variance accounted for (R = .49 vs .38).

To summarize, these findings reflect a substantial relationship between preschool regulation and preschool cognitive performance, both in the correlations and the regressions. These relationships hold after removing the effects of infant regulation, age, and parental SES. The pattern of relationships was as strong for the non-confounded criterion of Social Cognitive Composite as it was for the confounded criterion of Block Design. For the Cognitive Competence Composite, which minimized the confounding due to Block Design, the relationship was also strong. Although not as striking as the robust longitudinal relationships between infant regulation and cognitive performance, these concurrent relationships suggest that the regulatory styles of preschoolers do play a substantial and independent role in their cognitive competence.
Given the statistically independent contributions of infant and preschool regulation to preschool cognitive competence, it is of interest to explore their joint contributions. All 13 regulation composite variables were entered into a multiple regression for each of the three cognitive competence criteria. The multiple correlation of this full set of predictors with Block Design was not significant, due perhaps to the collinearity of the predictors and the reduced power attributable to the increased number of predictors. The multiple correlations with Social Cognitive Competence (R=.49) and with the Cognitive Competence Composite (R=.51) were each significant (p<.05); these regressions are shown in Table 10.

For the Social Cognitive Composite, three individual predictors were significant at p<.05: Positive Affect (infancy), Positive Affect/Challenge (preschool), and Anger (preschool). As expected, the first two were positive coefficients, and the last was negative, replicating patterns noted above. For the Cognitive Competence Composite, the pattern was the same except that the infant regulation composite of Positive Affect was at p<.10.

Note also the proportion of variance accounted for by the combined set of regulation variables relative to their separate contributions (see Tables 5, 9, and 10). For the Social Cognitive Composite, the infant, preschool, and combined proportions of variance accounted for are 12%, 14%, and 24%, respectively; for the Cognitive Competence Composite, these figures are 11%, 16%, and 26%. This further supports an interpretation that the regulation variables from infancy and preschool make roughly equivalent contributions to variance in cognitive
Table 10

Prediction of Competence by all Observational Infant and Preschool Regulation Variables

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Cognitive Competence Composite</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.51**</td>
<td>.49**</td>
</tr>
<tr>
<td>R Squared</td>
<td>.26</td>
<td>.24</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Predictor β Coefficients

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Cognitive Competence Composite</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect</td>
<td>.803</td>
<td>.943*</td>
</tr>
<tr>
<td>Initial Attention</td>
<td>.388</td>
<td>.365</td>
</tr>
<tr>
<td>Sustained Attention</td>
<td>-1.198*</td>
<td>-1.105*</td>
</tr>
<tr>
<td>Social Monitoring</td>
<td>-1.387</td>
<td>-.886</td>
</tr>
<tr>
<td>Social Enjoyment</td>
<td>-.875</td>
<td>-1.335</td>
</tr>
<tr>
<td>Anger</td>
<td>-.751*</td>
<td>-.666*</td>
</tr>
<tr>
<td>Social-Novelty</td>
<td>.349</td>
<td>.127</td>
</tr>
<tr>
<td>Social-Peak/Challenge</td>
<td>.228</td>
<td>.185</td>
</tr>
<tr>
<td>Attention General</td>
<td>-.838</td>
<td>-.772</td>
</tr>
<tr>
<td>Attention Challenge</td>
<td>.179</td>
<td>.037</td>
</tr>
<tr>
<td>Positive Affect-Novelty</td>
<td>-.021</td>
<td>.011</td>
</tr>
<tr>
<td>Positive Affect-Challenge</td>
<td>.502*</td>
<td>.436*</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01

Note: Block Design is not included; as a measure of cognitive competence, it is confounded with preschool measures of self-regulation.
competence, and that these contributions are almost entirely independent and additive rather than overlapping.

**Parentally Reported and Behaviourally Observed Regulation**

In addition to the regulation variables obtained from the coding of behavioural observations, parents were asked to report on their preschoolers' regulatory behaviours. These were consolidated into four composite variables: Internalizing and Externalizing from the CBCL; and Attentional Flow and Reactivity, composed from two research instruments in wide use (see Methods for details of scale construction).

These scales were employed in two sets of regression analyses. The first set addressed whether parentally reported regulation was predictive (concurrently) of preschool cognitive competence. The four parental report scales were entered in a multiple regression analysis of the three key cognitive variables used in the prior analyses, and the results are shown in Table 11.

```
Insert Table 11 about here
```

As can be seen from Table 11, these multiple correlations were substantially smaller, and none were significant at p<.10. The lack of relationships may be due to several factors. It may be that the range of behaviours requested on these self-report scales were sufficiently non-normative that they did not capture the relevant regulatory variance in this normative sample. Perhaps parents were unwilling to report such behaviours for reasons of social desirability. Another possibility is that the regulatory
Table 11

Cognitive Competence Predicted by Parental Reports of Preschool Regulation

<table>
<thead>
<tr>
<th></th>
<th>Cognitive Competence Composite</th>
<th>Block Design</th>
<th>Social Cognitive Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.19</td>
<td>.20</td>
<td>.16</td>
</tr>
<tr>
<td>R Squared</td>
<td>.04</td>
<td>.04</td>
<td>.03</td>
</tr>
<tr>
<td>N</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Predictors: Reactivity, Attentional Flow, Internalizing, Externalizing

Note: none of the predictors are significant at p<.10 or less, nor are any zero-order r's significant at that level.
capabilities and styles displayed by infants and children in challenging situations are more relevant to their cognitive competence than those routinely observed by parents in everyday situations, and hence the behavioural observations were tapping into more relevant variance than the parental report questionnaires.

This raises the question of the relationship between behaviourally observed and parentally reported regulation. Accordingly, the four parental report scales were each regressed on the set of infant regulation composite variables and the set of preschool regulation composite variables. There were no significant predictions from infant regulation to parentally reported preschool regulation. The preschool regulation composite variables (behavioural) were grouped by type (attention, emotion, and social) for separate factor analyses. These regressions did reveal a number of significant predictions to parentally reported regulation, as shown in Table 12.

Insert Table 12 about here

For Attentional Flow, both attention regulation (R=.31) and emotion regulation (R=.27) yielded significant multiple correlations. For Reactivity, none of the three regressions were significant. For Internalizing and Externalizing, all three regressions in each case showed a significant association. These were all similar in magnitude (R's ranging from .23 to .27).

Taken together, the findings from these analyses of parentally reported regulation support the value of behavioural observations of regulation, both for the clarification of underlying regulatory processes and for discovering the links between regulation and competence.
Table 12

Selected Preschool Regulation Composite Variables as Predictors of Parental Reports of Preschool Regulation

**Set One: Attention Regulation**

<table>
<thead>
<tr>
<th>Preschool Variables</th>
<th>CBC-L Internalizing Score</th>
<th>CBC-L Externalizing Score</th>
<th>Reactivity</th>
<th>Attentional Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.23&lt;sup&gt;+&lt;/sup&gt;</td>
<td>.231&lt;sup&gt;+&lt;/sup&gt;</td>
<td>.046</td>
<td>.31**</td>
</tr>
<tr>
<td>R Squared</td>
<td>.053</td>
<td>.053</td>
<td>.002</td>
<td>.094</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Attention General: 
-1.711<sup>*</sup>  
Attention Challenge: 
-3.47  
-1.308  
1.001  
2.421**

<sup>+</sup>p<.10, <sup>*</sup>p<.05, <sup>**</sup>p<.01

**Set Two: Emotion Regulation**

<table>
<thead>
<tr>
<th>Preschool Variables</th>
<th>CBC-L Internalizing Score</th>
<th>CBC-L Externalizing Score</th>
<th>Reactivity</th>
<th>Attentional Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.27&lt;sup&gt;+&lt;/sup&gt;</td>
<td>.27&lt;sup&gt;+&lt;/sup&gt;</td>
<td>.173</td>
<td>.272&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>R Squared</td>
<td>.072</td>
<td>.073</td>
<td>.03</td>
<td>.074</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Positive Affect - Novel: 
-.297  
.233  
-.3

Positive Affect - Challenge: 
-.608<sup>+</sup> 
-1.212**  
1.309***

Anger: 
-.624  
-.599  
.359

<sup>+</sup>p<.10, <sup>*</sup>p<.05, <sup>**</sup>p<.01, <sup>***</sup>p<.001

**Set Three: Social Variables**

<table>
<thead>
<tr>
<th>Preschool Variables</th>
<th>CBC-L Internalizing Score</th>
<th>CBC-L Externalizing Score</th>
<th>Reactivity</th>
<th>Attentional Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.241&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.264&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.13</td>
<td>.205</td>
</tr>
<tr>
<td>R Squared</td>
<td>.058</td>
<td>.07</td>
<td>.017</td>
<td>.042</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Social - Novel: 
-.113  
1.83<sup>+</sup>  
-

Social - Peak/Challenge: 
-1.844<sup>*</sup>  
-2.78**  
-

<sup>*</sup>p<.10, <sup>*</sup>p<.05, <sup>**</sup>p<.01,
Discussion

On the basis of the findings from this investigation, the three key developmental questions can be answered confidently in the affirmative. Infant regulation is robustly related to preschool cognitive competence; it is also substantially and specifically related to theoretically similar aspects of preschool regulation; and preschool regulation is clearly associated with preschool cognitive competence. This pattern of longitudinal and concurrent relationships establishes a clear connection between patterns of self-regulation and cognitive performance during the developmentally sensitive early years of life. These results build on and extend previous research that has illuminated important connections among patterns of social, emotional, and cognitive development (Lewis, 1993b; Main, 1983).

In addition to establishing these broad connections, this investigation also provided evidence of consistent and interpretable relationships among specific processes and outcomes. The significant role of positive affect in infancy and early childhood, assessed during socially and cognitively challenging situations, seems to suggest an important role for overall emotional tone in self-regulation and competence. Recall that this composite was constructed in both infancy and early childhood from high levels of positive affect and low levels of negative or anxious affect. This developmental pathway may relate to more psychodynamic constructs such as defensiveness, in that openness to experience may be a key factor in both self-regulation and the acquisition of cognitive skills.

The infant composite of Social Monitoring, which showed consistently negative, albeit small, relationships to other regulation variables and to cognitive criteria, is another example. At first glance, it might seem that very high levels of attention to the social experience might make a positive
contribution. But an overfocusing on the social context in circumstances that call for sustained attention to external task demands seems instead to be a slight inhibitor of expertise acquisition. This may arise from wariness in some circumstances, or from a high degree of investment in social approval, as was seemingly reflected in the relationship of the composite Social Enjoyment to the Social Cognitive Composite.

These examples illustrate the value of including detailed process analyses in longitudinal investigations. Patterns of relationships that might not be apparent on the surface become clearer with this methodological approach, which has been described as the reconstruction of cognitive development (Keating & MacLean, 1988).

Another benefit arises from the ability to contrast longitudinal and concurrent relationships. From comparisons of results from the three key developmental questions, a clear picture emerges. Infant regulation makes a somewhat substantial contribution to preschool competence, independent of preschool regulation. Similarly, preschool regulation makes a somewhat substantial contribution to preschool competence, independent of infant regulation. Together, they account for a robust amount of cognitive variance, 26% in the case of the Cognitive Competence Composite. But they are not independent of each other. There is a strong and specific relationship between infant and preschool regulation.

The developmental pathway that captures these patterns may be described as follows. Infants who have developed good emotional, attentional, and social regulatory capabilities are more likely to have habits of learning that contribute to their subsequent cognitive development (the independent contribution of infant regulation to preschool competence). They are also more likely to continue to acquire other developmentally
appropriate regulatory capabilities (the significant association of infant and preschool regulation). Preschoolers with good emotional, attentional, and social regulation are likely to perform better in challenging cognitive situations (the independent contribution of preschool regulation to preschool competence). The joint contribution of these regulatory variables at both Time 1 and Time 2 is substantial. This pattern of findings offers support to the notion that these various dimensions of competence -- cognitive, attentional, emotional, and social -- may become integrated over the course of early development, leading to habits of mind that are of signal importance in subsequent development (Keating, in press).

Although these findings offer strong support for the links between the first year of life and preschool, they do not specify how these patterns of infant regulation are initially established, nor how the contexts of development during the intervening years support, or fail to support them. The findings of Lewis (1993b) suggest that the nature of the parent-child social and emotional connection from 3- to 6-months of age may be a key source of variance in establishing patterns of regulation and competence. Future investigations of these developmental origins, and of the continuing nature of the parent-child interactions on sustaining these pathways are likely to be highly informative.
References


Appendixes
## Gender By Age By Condition (Cross Sectional View)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age (months)</th>
<th>Two Location</th>
<th>Five Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition One</td>
<td>Condition Two</td>
<td>Condition One</td>
</tr>
<tr>
<td>Male</td>
<td>9 Months</td>
<td>3 (9.12)</td>
<td>6 (9.1)</td>
</tr>
<tr>
<td></td>
<td>12 Months</td>
<td>5 (12.15)</td>
<td>7 (12.17)</td>
</tr>
<tr>
<td>Female</td>
<td>9 Months</td>
<td>4 (9.21)</td>
<td>6 (9.15)</td>
</tr>
<tr>
<td></td>
<td>12 Months</td>
<td>6 (12.25)</td>
<td>8 (12.06)</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>18</td>
<td>27</td>
</tr>
</tbody>
</table>
Appendix B1

Infant Self-regulation Coding Scheme

Rating Scales: Five point scales (1=low; 3=medium; 5=high) and are completed for every 10 seconds interval of each hiding episode. The measures represent the degree of behaviours reflecting the presence or absence of the following constructs.

Start Point: Start coding the first 10 second epoch when the experimenter begins to tap the toy across the table.

1) Positive Affect: smiling, cooing, laughing
   -directed toward either a person or an object
   1 - No positive affect
   2 - Sober interest
   3 - Interest, smiles, pleasant
   4 - Smiles, vocalizes
   5 - Smiles, much vocalizing, body movements

2) Negative Affect: crying, fussing, frowning
   -directed toward any source
   1 - No negative affect
   2 - Unpleasant, frowns
   3 - Frowning, fussing
   4 - Fussing, crying, angry
   5 - Crying, rage, rigid, thrusting body movements
3) Intensity of Task Engagement: degree of baby's interest and participation in the game

1 - Distracted, looking at something else not related to task

2 - Mild interest, somewhat involved in the task

3 - Interested

4 - Interest, excitement, enthusiasm

5 - Intense interest, purposeful direct body movements

4) Social Referencing: infant's use of other to seek information.

- Directed toward persons (parent/experimenter)

1 - No social referencing

2 - One short social reference

3 - One long social reference (at least 3 seconds)

4 - More than one long or short social reference

5 - Frequent social references

5) Social Enjoyment: amount of social pleasure that baby experiences from engagement in the game

- Directed towards persons parent or experimenter

1 - No enjoyment, negative affect or behaviour

2 - Sober or interested

3 - Happy and pleasant

4 - Very happy and exuberant, wide smiles

5 - Ecstatic, smiles and squeals, body movements
6) Social Attention: infant's degree of interest in objects vs. interest in people
1 - Does not look at experimenter or parent, absorbed in parts of table clothing, object
2 - Looks at experimenter or parent when encouraged to do so
   i.e. - during 5 second delay while counting and clapping
3 - Looks at experimenter or parent spontaneously for brief periods
4 - Focuses on experimenter or parent for more than two seconds at least two times
5 - Focuses on experimenter or parent for long periods (more than four seconds)

7) Efficacy of Co-regulation: ability of mother-infant dyad to function in service of task completion
1 - Dyad is not working together to complete task
2 - One member of dyad makes one attempt to use other for co-regulation i.e. baby may lean back into parent for physical support or comfort or parent may physically reorient infant toward the table
3 - One member of dyad makes more than one attempt to use the other for co-regulation
4 - Both members of the dyad use each other to co-regulate and are somewhat effective
5 - Both members of the dyad use each other to co-regulate and are highly effective
<table>
<thead>
<tr>
<th>Timing</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Positive Affect</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>A3</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>B2</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Negative Affect</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>A3</td>
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<tr>
<td></td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B2</td>
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<tr>
<td>Intensity of Engagement</td>
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<td></td>
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<td></td>
<td>A3</td>
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<tr>
<td></td>
<td>B1</td>
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<td>Social Attention</td>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>B1</td>
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<td></td>
<td>A3</td>
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<td></td>
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<td></td>
<td>B1</td>
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<td></td>
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Subject# | Age | Coder | Date of Testing | Scales 1-5; 1=low; 3=med; 5=high |
Condition: | Sex | Tape# | S A T F | (9 indicates "not codeable") |
Appendix C1

Preschool Self-regulation Coding Scheme

1. POSITIVE AFFECT: this positive affect can be directed at self, other, or task

1=NO POSITIVE AFFECT is observed

2=WILLING
- uncertain emotional tone
- waiting with neutral or positive attitude
- tentative
- looks for some reassurance when task completed

3=PLEASANT
- small smiles
- mostly relaxed body posture
- some eye contact

4=HAPPY / PROUD
- wide smiles
- talkative
- displays appropriate eye contact
- points out accomplishments
- excitedly awaits opportunity to work on next design
- confident
- states that s/he likes the game
- makes confident statements such as "I can do this"
- sitting straight (good posture)

5=TRIUMPH / DELIGHT
- exclaims "yes; wow" when finished trial
- dropped mouth; wide eyes; raised eyebrows
- raises hands into air
- jumps from seat; states that s/he loves the game
- makes self-congratulatory statements such as "wow, I'm really good at this"
- leans body into / over table to work on task
2. NEGATIVE -ANXIOUS AFFECT: this negative affect is directed at self.

1=NO NEGATIVE-ANXIOUS AFFECT is observed

2=FLAT AFFECT
- avoids eye contact
- fidgets in chair
- moves hands around
- slouching
- some vocalization
- hugs self

3=MILDLY ANXIOUS
- unhappy
- wide eyes
- self-touching: bites nails; chews hair; hides behind hair/hands; scratches head
- no vocalization/silent
- communicates physically rather than verbally (i.e. nods head in agreement or disagreement)
- labile (i.e. shows fleeting smiles and frowns; leans forward to engage in task and then withdraws)
- scrunches face or looks dismayed when presented with new block design, sighs
- obsessive over details of block design, after successfully completed

4-CLEARLY ANXIOUS
- pouts
- gulps
- tries not to cry
- averts gaze
- leans head to side of shoulder ("hiding"/averting)
- dumps head into hands
- baby talk (no assertion of "I" rather "me want this" "me can't finish this"
- asks whether design is finished or not
- heavy breathing

5=HIGHLY ANXIOUS
- starts to cry
- can't focus on task
- avoids experimenter
- no spontaneous vocalization
- slouches in chair
- leans back
- drops head to chest
- very upset (shows shock, fright, dismay) when presented with new block design
- gives up, stops interacting, "freezes"
- repetitive self-soothing body motion (rocking & hugging)
3. NEGATIVE AFFECT - ANGER / DEFIANCE: this negative affect is directed at other.

1-NO NEGATIVE ANGRY-AFFECT is observed

2=IRRITATED
- flat affect
- some resistance to Experimenter
- stares at Experimenter with flat facial expression
- tense body posture

3=ANGRY / RESISTANT
- tells Experimenter that s/he does not like the task
- rigid body posture
- looks at Experimenter angrily
- questions Experimenter regarding when s/he'll be finished/next task
- rolls eyes at Experimenter

4=ANGRY / DEFIANT
- tells Experimenter that s/he does not have to complete task
- tries to assert physical control of task by grabbing blocks and book
- glares at Experimenter
- tries to assert that blocks look like picture or design when they don't
- states that design cannot be made with available blocks

5=VERY ANGRY / VERY DEFIANT
- tells Experimenter that s/he will not complete task
- smashes blocks
- won't give blocks to experimenter
- defiant and rigid body posture (rigidity of anger, not rigidity of anxiety "freezing"
- arms akimbo / direct challenge / threatening violence
4. INTENSITY OF TASK ENGAGEMENT: degree of involvement in the task

1=MOSTLY OFF TASK
- completely or mostly off task
- engages in conversation or behaviour that is not relevant to the task

2=SOMETHING INTERESTED IN TASK
- sober
- fair amount of distractibility
- some behaviour / conversation that is non task related

3=INVOLVED IN TASK
- comprehends task
- follows proceedings
- distractions affect performance

4=VERY ATTENTIVE TO TASK
- attentive
- persistent
- shifts attention amongst blocks, book, design, and experimenter
- asks specific questions about progress
- eager to begin next design
- private speech

5=ABSORBED IN TASK
- highly attentive
- breaks design down into identifiable parts while working on it
  i.e. "that is two triangles"
- does not engage with experimenter while working on design
- leans forward over table
- eagerly anticipates the next design and tracks experimenter's movements while doing so
- very persistent
- shifts attention amongst book, design, and blocks
- notes that finished design looks like something else
  i.e. that looks like an "L" to me and a "7" to you.
5. RESPONSE TO PERCEIVED ERROR: the child's affective reaction to the perception of a task error, that is, the perception that his/her design is different from the model

1= DOES NOT PERCEIVE ERROR
- child does not recognize or indicate that s/he is aware of discrepancy between his/her block design and the model
- monitors progress little or not at all

2= ACTIVELY AVOIDS PERCEIVING ERROR
- child states to experimenter that his/her design and the model are the same although the two designs are clearly different
- child focuses on something else; engages in off task behaviour/conversation
- monitors progress rarely

3= UNCOMFORTABLE WITH PERCEIVED ERROR
- when child perceives a difference between his/her design and the model, the child shows negative-anxious or negative-angry affect
- monitors progress intermittently

4= COMFORTABLE WITH (DOES NOT FEAR) PERCEIVED ERROR
- when child perceives a difference between his/her design and the model, the child does not show an increase in negative affect
- child shifts attention to model or experimenter to examine perceived error
- monitors progress regularly and / or efficiently

5= INVESTIGATES PERCEIVED ERROR TO IMPROVE PERFORMANCE
- when child perceives a difference between his/her design and the model, the child does not show an increase in negative affect, and the child shows an increase in his/her intensity of task engagement in order to investigate the perceived error
- child only studies the model (and does not shift attention to Experimenter) to investigate perceived error
- monitors progress actively and continuously
6. SOCIAL PARTICIPATION IN GAME SCRIPT: degree of involvement in the social aspect of the task.

1=WANTS OUT
-child wants out of the situation and no longer wants to participate in the game
-negative affect
-child asks when task will be finished
-child shows much off task behaviour/conversation

2=WITHDRAWN
-child withdraws from the game situation
-shows little interest in the task
-avoids eye contact
-avoids conversation with Experimenter
-poor body posture i.e. child slouches

3=WILLING PLAYER
-child is somewhat involved in the game
-child forces self to display socially appropriate behaviour
i.e. sits up straight with hands folded and has flat or negative affect

4=INVOLVED PLAYER
-child is involved in game component; enthusiastic about starting
-child congratulates self
-child follows Experimenter and then finishes standard statements i.e. "and then I'll tell you when I'm finished"
-child makes two or more social bids, whether or not they are appropriate
-child takes pleasure in success

5=EAGER PLAYER
-child views task as a game
-engages in social comparison i.e. "Am I doing better than most kids?"
-child sings theme song from jeopardy
-child recognizes the timed component of the game i.e. "I did that one really fast, didn't I"
-child anticipates next block design and views it as a challenge
-child makes persistent and / or insistent social bids for help
-child is excited about finishing one design and starting the next
6. **SOCIABILITY:** degree of enjoyment in social aspect of the task

1=**DISLIKES SOCIAL INTERACTION**
- child does interacts as little as possible with Experimenter
- averts gaze
- avoids eye contact
- body posture is tense, uncomfortable, or leaning away from interaction

2=**SHY**
- child is withdrawn, wary
- engages in some interaction with experimenter i.e. acknowledges experimenter when E talks to child
- child timidly states that s/he has finished the block design
- child finishes the signals to the experimenter that he/she has finished the design with eye contact

3=**PLEASANT**
- child is responsive to experimenter's requests
- comfortable body posture
- some eye contact

4=**HAPPY**
- outgoing
- initiates task relevant or appropriate conversation with Experimenter
- child confidently states when s/he has finished

5=**ENTHUSIASTIC**
- child is happy
- child is relaxed
- child initiates more conversation when task is completed
8. EFFICACY OF SELF-REGULATION: degree of attentional/ emotional control and consequent ability to move between or negotiate the transitions between different parts of the task.

1=DYSREGULATED
- child is dysregulated and cannot regulate affect or focus attention
- child engages in off task conversation and behaviour
- little or no interaction with experimenter

2=FRAGILE SELF-REGULATION
- child is sober
- child is wary
- child is tentative
- child is withdrawn
- child is somewhat involved in the task
- child's anxiety disrupts task performance
- child is upset when presented with new trial
- child avoids experimenter

3=INTERMITTENT SELF-REGULATION
- child is pleasant
- interested in the task
- child is somewhat successful at task
- child is displays no negative affect when presented with a new trial
- child acknowledges experimenter

4=STABLE SELF-REGULATION
- child is happy
- child is relaxed
- child is involved in and focused on the task
- child anticipates next trial and discusses task/session with experimenter
- child initiates conversation with experimenter

5=INTEGRATED SELF-REGULATION
- child is happy
- child is relaxed
- child is focused
- child is attentive
- child is persistent
- child does not interact with experimenter while working on task
- upon task completion, child initiates verbal or physical interaction with experimenter
- child eagerly anticipates next trial
- child recognizes own success/failure and accepts it
- child has it all together
Appendix C2

Preschool Regulation Coding Sheet

<table>
<thead>
<tr>
<th>Timing</th>
<th>Trial #</th>
<th>0-30 Sec.</th>
<th>30 Sec. - Design End</th>
<th>30 Sec. Post Design</th>
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<tbody>
<tr>
<td><strong>1. Positive Affect</strong></td>
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<td><strong>5. Response to Perceived Error</strong></td>
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<tbody>
<tr>
<td>Infant Subject #</td>
<td>Sex</td>
<td>Tape</td>
<td>BD Ends At:</td>
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Appendix D1

Inference Task Protocol

Class One Story - Situational Cues

Picture #1

Story for Male and Female Subjects

(Pointing to the picture) Do you see Mickey Mouse and Minnie Mouse in this picture? Mickey and Minnie both want the present with the purple bow on it. Do you see Mickey and Minnie reaching for the present with the purple bow on it? They both want the present but only one of them can have it.

Picture #2

Story for Female Subjects Only

Oh See! Minnie Mouse reached the present first. Who has the present with the purple bow on it? That's right, Minnie has the present! How do you think Minnie Mouse feels? Why does she feel this way? How do you know she feels this way?

How do you think Mickey feels? Why does he feel this way? How do you know he feels this way?

Picture #2

Story for Male Subjects Only

Oh See! Mickey Mouse reached the present first. Who has the present with the purple bow on it? That's right, Mickey has the present. How do you think Mickey feels? Why does he feel this way? How do you know that he feels this way? How do you think Minnie feels? Why does she feel this way? How do you know she feels this way?
Class 2 Story - Psychological Cues

Picture #1

For Male and Female Subjects

(Pointing to the Picture) Do you see Mickey Mouse and do you see Minnie Mouse? They are both going to the pet store. See the Pet Store. Mickey and Minnie are going into the Pet Store because they both want to get a puppy.

Picture #2

For Female Subjects Only

Oh Wow! Minnie Mouse and Mickey Mouse both got a puppy from the pet store.
Do you see Mickey with his puppy and Minnie with her puppy?
How do you think Minnie Mouse feels?
Why do you think that she feels this way?
How do you know that she feels this way?
How do you think Mickey feels?
Why do you think he feels this way?
How do you know he feels this way?

Picture #2

For Male Subjects Only

Oh Wow! Minnie Mouse and Mickey Mouse both got a puppy from the pet store.
Do you see Mickey with his puppy and Minnie with her puppy?
How do you think Mickey feels?
Why do you think he feels this way?
How do you know he feels this way?
Class One Story - Situational Cues

Picture #3

Story for Both Male and Female Subjects

Note: Replace same sex character name with target child’s name

(Pointing to the picture) Do you see the boy and the girl in the picture? The boy's name is John and the girl's name is Kim. Do you see the Barnie Doll? Both John and Kim want the Barnie Doll.

Picture #3

For Female Subjects Only

Oh See! ____ (target child's name) has reached the Barnie Doll first. Who has Barnie?
That’s right, ____ (target child's name) has Barnie.
Why do you think that she feels this way?
How do you know that she feels this way?
How do you think John feels?
Why do you think that he feels this way?
How do you know that he feels this way?

Picture #3

For Male Subjects Only

Oh See! Picture ____ (target child's name) has reached the Barnie Doll first. Who has Barnie?
That’s right, ____ (target child's name) has Barnie.
How do you think ____ (target child's name) feels?
Why do you think that he feels this way?
How do you know that he feels this way?
How do you think Kim feels?
Why do you think that she feels this way?
How do you know that she feels this way?
Picture #4

Story for Both Male and Female Subjects

Note: Replace same sex character name with target child’s name

(Pointing to the picture) Do you see John and do you see Kim? They are both going into the Toy Store. See the Toy Store. John and Kim are going into the Toy Store because they both want to get a Baby Bop Doll.

Picture #4

For Female Subjects Only

Oh Wow! (target child's name) and John both got a Baby Bop doll from the Toy Store. Do you see (target child’s name) with her Baby Bop and John with his Baby Bop?

How do you think (target child’s name) feels?
Why do you think that she feels this way?
How do you know that she feels this way?
How do you think John feels?
Why do you think that he feels this way?
How do you know that he feels this way?

Picture #4

For Male Subjects Only

Oh Wow! (target child’s name) and Kim both got a Baby Bop doll from the Toy Store. Do you see (target child’s name) with his Baby Bop and Kim with his Baby Bop?

How do you think (target child’s name) feels?
Why do you think that he feels this way?
How do you know that he feels this way?
How do you think Kim feels?
Why do you think that she feels this way?
How do you know that she feels this way?
Appendix D2

Inference Story Coding Scheme

Class One Stories

Situational Inference Stories (#1 & #3): The information or cues needed both to determine and explain the emotions of the characters in the story are an aspect of the event itself. Each character, for example, did or did not receive a present or a Barney Doll.

-1 point is given if the subject identifies the correct emotion
-1 point is given if the subject gives a situational explanation

Class Two Stories

Psychological Inference Stories (#2 & #4): The facial expressions identify the story characters' emotions but the situation is an inadequate source of information to explain these feelings because the event that has happened to the character is objectively the same. An adequate explanation of the emotions, therefore, requires one to infer individual or psychological differences between the characters. Each character, for example, is happy or sad despite having received either a puppy or a Baby Bop doll.

-1 point is given if the subject identifies the correct emotion
-1 point is given if the subject gives a psychological explanation
Appendix E1

Sample Theory of Mind Task

Condition One-Mickey Mouse

Female Target Child

This is Raggedy Ann's house. I want you to pretend that Ann is a real person. When she is in her house, she cannot hear what we are saying and she cannot see what we are doing.

LIFT COVER AND SHOW FULL PICTURE OF MICKEY MOUSE

What do you think this is a picture of?

State: "I see" or "Interesting" or "Uh hum"

CLOSE COVER

Now we are going to get Ann from her house and show her the picture. Ann has never seen this picture before, but we are going to show it to her like this.

OPEN WINDOW ____ ONLY, AND POINT TO IT

Will you please get Ann from her house?
What does Ann think that this (pointing to frame) is a picture of?
So, Ann thinks that it's a picture of _______ (repeat response).

State: "I see" or "Interesting" or "Uh hum"

CLOSE WINDOW THAT WAS JUST SHOWN TO ANN

Did you come here today with a friend?
What is your friend's name?
Your friend ____ (state peer's name) is in the other room. When she is in the other room, she cannot hear what we are saying or see what we are doing.
OPEN WINDOW ____ ONLY, AND POINT TO IT.

Your friend ____ (state peer's name) has never seen this picture before (pointing to frame). What would ____ (state peer's name) think that this is a picture of?
So, ____ (state peer's name) would think that it is a picture of _______ (repeat target child's response).

State: "All right, lets do another"
Sample Theory of Mind Task

Condition Two - Giraffe
Female Target Child

This is Raggedy Ann's house. I want you to pretend that Ann is a real person. When she is in her house, she cannot hear what we are saying and she cannot see what we are doing.

LIFT COVER AND SHOW FULL PICTURE OF THE GIRAFFE

What do you think this is a picture of?

State: "I see" or "Interesting" or "Uh hum"

CLOSE COVER

Now we are going to get Ann from her house and show her the picture. Ann has never seen this picture before, but we are going to show it to her like this.

OPEN WINDOW ___ ONLY, AND POINT TO IT

Will you please get Ann from her house?
What does Ann think that this (pointing to frame) is a picture of?
So, Ann thinks that it's a picture of __________(repeat response).

State: "I see" or "Interesting" or "Uh hum"

CLOSE WINDOW THAT WAS JUST SHOWN TO ANN

Did you come here today with a friend?
What is your friend's name?
Your friend ____ (state peer's name) is in the other room. When she is in the other room, she cannot hear what we are saying or see what we are doing.

RE-OPEN WINDOW ___ ONLY (THE ONE THAT WAS JUST SHOWN TO ANN), AND POINT TO IT.

Your friend ____ (state peer's name) has never seen this picture before. What would ____ (state peer's name) think that this (pointing to frame) is a picture of?
So, ____ (state peer's name) would think that it is a picture of ___ (repeat target child's response).

If child gives two identical answers ask:
"Why do Ann and your friend (state name only) both think that the picture (pointing to it) is the same thing?"

If child gives two different answers ask:
"Why do Ann and your friend (state name only) think that the picture (pointing to it) is two different things?"

State: "All right, let's do another"
Sample Theory of Mind Task

Condition Three - Shark
Female Target Child

This is Raggedy Ann's house. I want you to pretend that Ann is a real person. When she is in her house, she cannot hear what we are saying and she cannot see what we are doing.

LIFT COVER AND SHOW FULL PICTURE OF THE SHARK
What do you think this is a picture of?

State: "I see" or "Interesting" or "Uh hum"

CLOSE COVER
Now we are going to get Ann from her house and show her the picture. Ann has never seen this picture before, but we are going to show it to her like this.

OPEN WINDOW _____ ONLY, AND POINT TO IT
Will you please get Ann from her house?
What does Ann think that this (pointing to frame) is a picture of?
So, Ann thinks that it's a picture of ________ (repeat response).

State: "I see" or "Interesting" or "Uh hum"

CLOSE WINDOW THAT WAS JUST SHOWN TO ANN
Did you come here today with a friend?
What is your friend's name?
Your friend _____ (state peer's name) is in the other room. When she is in the other room, she cannot hear what we are saying or see what we are doing.

RE-OPEN WINDOW _____ ONLY (THE ONE THAT WAS JUST SHOWN TO ANN), AND POINT TO IT.
Your friend _____ (state peer's name) also saw this picture (pointing to frame) and she does not think that it is a ________ (state Ann's response) What would _____ (friend) think that this is a picture of?
So, _____ (state peer's name) would think that it is a picture of ____ (repeat target child's response).

State: "All right, lets do another"
Appendix E2

Theory of Mind Task Coding Scheme

There are three conditions, two pictures in each condition, and 2 key hole views in each picture.

In each condition, the child the entire picture. Following this, a cover is placed over the picture. There are two windows in the cover with a smaller cover on each of them. When the smaller covers are lifted, a keyhole view of the larger picture can be seen.

In condition one, the child is asked to state how the doll would describe one keyhole view and how his/her friend (although not present) would describe the other keyhole view.

In condition two, the child is asked to state how both the doll and his/her friend would describe the same keyhole view.

In condition three, the child is again asked to state how both the doll and his/her friend would describe the same keyhole view. However, after the child describes the doll’s perspective in this condition, the experimenter encourages the child to generate a different description for his/her friend. Before the subject states how his/her friend might describe the keyhole view, the experimenter states: "If your friend did not think this was a picture of ___(doll’s view), what else might he/she think this was a picture of?"

To measure the subject’s representational theory of mind, each description of a keyhole view is coded using the following coding scheme:

0 = Actual Picture - answer describes the actual picture
1 = Similar - answer describes a picture that is somewhat similar to the actual picture
2 = Other - answer describes a picture that is distinctly different from actual picture

Additionally, the responses for conditions two and three (where both the friend and the doll have been shown the same picture) are recoded to assess the subject’s interpretive theory of mind using the following coding scheme:

0 = Egocentric - the child has said that both the friend and the doll think the window is the part of the whole picture
1 = Repetitive - the child has said that the friend and doll both think it is a picture of the same thing
2 = Mixed - the doll and the friend think the picture is two different things but the second answer if heavily influenced by the first.
3 = Interpretive - the doll and the friend think the keyhole views are distinctly different pictures
Appendix F1

Reactivity Scale

The following questions concern aspects of children's temperament of normal behavioural style. Please read each question carefully, and decide how true each statement is in regard to your child. It is important that you answer as truthfully as possible; your responses will be totally confidential.

Please use the following scale to answer each question, and write the number that reflects your answer in the space to the left of each item:

<table>
<thead>
<tr>
<th>Extremely Untrue</th>
<th>Quite Untrue</th>
<th>Slightly Untrue</th>
<th>Neither True or Untrue</th>
<th>Slightly True</th>
<th>Quite True</th>
<th>Extremely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

* 1. My child responds very emotionally to things around him/her.
* 2. When my child gets excited, his/her voice sometimes quivers when speaking.
* 3. The sight of someone who is hurt badly affects my child strongly.
* 4. When my child gets angry, it is easy for him/her to still be rational and not overreact.
* 5. When my child feels anxiety, it is normally very strong.
* 6. My child is slow to become angry, nervous, or upset.
* 7. My child's palms usually sweat during an important event.
* 8. My child tends to get nervous, tense, or distressed easily.
* 9. My child has to go to the bathroom more often than usual when she/he gets excited about something.
* 10. My child is calm and not easily aroused.
* 11. My child does not often show physical reactions (e.g. sweating, shaking, tightness) when he/she is emotionally aroused.
* 12. My child is deeply affected by stories, movies, and events he/she observes.
* 13. My child's breathing usually remains smooth and steady in an exciting situation.
* 14. When my child is happy, he/she is contented and calm rather than exhilarated and excited.
* 15. When my child feels emotion, it is difficult to calm him/her down.
* 16. My child's emotions tend to be more intense than those of other children his/her age.

Note: Items marked with an asterisk were reversed before the scale mean was calculated.
Appendix F2

Attentional Flow Scale

The following questions concern aspects of children's temperament of normal behavioural style. Please read each question carefully, and decide how true each statement is in regard to your child. It is important that you answer as truthfully as possible; your responses will be totally confidential. Please use the following scale to answer each question, and write the number that reflects your answer in the space to the left of each item.

<table>
<thead>
<tr>
<th>Extremely Untrue</th>
<th>Quite Untrue</th>
<th>Slightly Untrue</th>
<th>Neither True or False</th>
<th>Slightly True</th>
<th>Quite True</th>
<th>Extremely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

My child:

1. When picking up toys or other jobs, usually keeps at the task until it's done.
2. Is hard to get his/her attention when she/he is concentrating on something.
3. When practicing an activity, has a hard time keeping her/his mind on it.
4. Can easily shift from one activity to another.
5. Will move from one task to another without completing any of them.
6. Has a lot of trouble stopping an activity when called to do something else.
7. When drawing or coloring in a book, shows strong concentration.
8. Has an easy time leaving play to come to dinner.
9. When building or putting something together, becomes very involved in what she/he is doing, and works for long periods.
10. Sometimes doesn't seem to hear me when I talk to him/her.
11. Has difficulty leaving a project she/he has begun.
12. Has a hard time concentrating on an activity to another.
13. Is easily distracted when listening to a story.
14. Has a hard time shifting from one activity.
15. Sometimes becomes absorbed in a picture book and looks at it for a long time.
16. Is good at games with rules, such as card games.
17. When watching TV, is easily distracted by other noises or movements.
18. Can easily leave off working on a project if asked.
19. Is distracted from her/his projects when you enter the room.
20. Often doesn't seem to hear me when s/he is working on something.
21. Often shifts rapidly from one activity to another.
22. Sometimes has a "dreamy" quality when others talk to him/her, as if he/she were somewhere else.
23. Will ignore others when playing with an interesting toy.

Note: items marked with an asterisk were reversed before the scale mean was calculated.
Appendix G1

B.01 WHAT IS THE HIGHEST GRADE OR LEVEL OF EDUCATION THAT YOU HAVE OBTAINED?

- No schooling
- Some elementary
- Completed elementary
- Some secondary
- Completed secondary
- Some community college, technical college, CEGEP or nurse's training
- Completed community college, technical college, CEGEP or nurse's training
- Some university
- Completed university (highest degree obtained ___________ )
Appendix G2

B.02 WHAT IS/WAS YOUR INCOME LEVEL FOR PRESENT/LAST PLACE OF WORK:

- $0.00 - 999.00
- $10,000 - 14,999
- $15,000 - 19,999
- $20,000 - 24,999
- $25,000 - 29,999
- $30,000 - 34,999
- $35,000 - 39,999
- $40,000 - 44,999
- $50,000 - 54,999
- $55,000 - 59,999
- $60,000 - 64,999
- $65,000 - 69,000
- $70,000 - 74,999
- $75,000 - 79,999
- $80,000 - 84,999
- $85,000 - 89,999
- $90,000 - 94,999
- $95,000 - 99,999
- $100,000 +
Appendix H

Construction of Composite Infant Regulation Variables

Table H.1

Construction of Infant Affect Regulation Variable, Factor Loadings

Using scree test, a one factor solution works well.

Eigenvalues and Proportion of Original Variance

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Magnitude</th>
<th>Variance Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value 1</td>
<td>6.086</td>
<td>.338</td>
</tr>
<tr>
<td>Value 2</td>
<td>1.998</td>
<td>.111</td>
</tr>
<tr>
<td>Value 3</td>
<td>1.574</td>
<td>.087</td>
</tr>
<tr>
<td>Value 4</td>
<td>1.202</td>
<td>.067</td>
</tr>
<tr>
<td>Value 5</td>
<td>.992</td>
<td>.055</td>
</tr>
<tr>
<td>Value 6</td>
<td>.906</td>
<td>.05</td>
</tr>
<tr>
<td>Value 7</td>
<td>.694</td>
<td>.039</td>
</tr>
<tr>
<td>Value 8</td>
<td>.638</td>
<td>.035</td>
</tr>
<tr>
<td>Value 9</td>
<td>.633</td>
<td>.035</td>
</tr>
</tbody>
</table>
The unrotated factor matrix offers a straightforward pattern.

<table>
<thead>
<tr>
<th>Affect Variable</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA/A1/10</td>
<td>.592</td>
</tr>
<tr>
<td>PA/A1/20</td>
<td>.671</td>
</tr>
<tr>
<td>PA/A1/30</td>
<td>.592</td>
</tr>
<tr>
<td>PA/A3/10</td>
<td>.695</td>
</tr>
<tr>
<td>PA/A3/20</td>
<td>.689</td>
</tr>
<tr>
<td>PA/A3/30</td>
<td>.381</td>
</tr>
<tr>
<td>PA/B1/10</td>
<td>.599</td>
</tr>
<tr>
<td>PA/B1/20</td>
<td>.602</td>
</tr>
<tr>
<td>PA/B1/30</td>
<td>.557</td>
</tr>
<tr>
<td>NA/A1/10</td>
<td>-.535</td>
</tr>
<tr>
<td>NA/A1/20</td>
<td>-.591</td>
</tr>
<tr>
<td>NA/A1/30</td>
<td>-.508</td>
</tr>
<tr>
<td>NA/A3/10</td>
<td>-.532</td>
</tr>
<tr>
<td>NA/A3/20</td>
<td>-.645</td>
</tr>
<tr>
<td>NA/A3/30</td>
<td>-.652</td>
</tr>
<tr>
<td>NA/B1/10</td>
<td>-.547</td>
</tr>
<tr>
<td>NA/B1/20</td>
<td>-.507</td>
</tr>
<tr>
<td>NA/B1/30</td>
<td>-.476</td>
</tr>
</tbody>
</table>

Note: PA=Positive Affect; NA=Negative Affect; A1=Trial A1; A3=Trial A3; B1=Trial B1; 10= the initial ten seconds of a trial; 20=the second 10 second segment of a trial; 30=the third 10 second segment of a trial.
Discussion of Table H.1

Based on this factor analysis and theoretical interpretation, the following composite affect variable was constructed, using standardized scores (i.e. Z-scores)

<table>
<thead>
<tr>
<th>Affect Variable</th>
<th>Formula</th>
</tr>
</thead>
</table>

Note: PA=Positive Affect; NA=Negative Affect; A1=Trial A1; A3=Trial A3; B1=Trial B1; 10= the initial ten seconds of a trial; 20=the second 10 second segment of a trial; 30=the third 10 second segment of a trial
Table H.2

Construction of Infant Attention Regulation Variables, Factor Loadings

These eigenvalues were based on a principal components analysis on all trials (A1,A3,B1) for the first 3 ten second segments.

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Magnitude</th>
<th>Variance Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value 1</td>
<td>3.627</td>
<td>.403</td>
</tr>
<tr>
<td>Value 2</td>
<td>1.408</td>
<td>.156</td>
</tr>
<tr>
<td>Value 3</td>
<td>1.156</td>
<td>.128</td>
</tr>
<tr>
<td>Value 4</td>
<td>.724</td>
<td>.08</td>
</tr>
<tr>
<td>Value 5</td>
<td>.64</td>
<td>.071</td>
</tr>
</tbody>
</table>

From the eigenvalues, either a 2 or 3 factor solution is adequate. However, on inspection of unrotated factor structure, Factor 3 is defined by only one variable, and has a complex pattern of loadings. To avoid this and to reduce the number of composite variables, a 2 factor solution is preferable.

Unrotated Factor Matrix

<table>
<thead>
<tr>
<th>Attention Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE/A1/10</td>
<td>.324</td>
<td>.482</td>
<td>.618</td>
<td>-.027</td>
</tr>
<tr>
<td>IE/A1/20</td>
<td>.559</td>
<td>.643</td>
<td>-.317</td>
<td>.126</td>
</tr>
<tr>
<td>IE/A1/30</td>
<td>.555</td>
<td>.594</td>
<td>-.438</td>
<td>.035</td>
</tr>
<tr>
<td>IE/A3/10</td>
<td>.62</td>
<td>.094</td>
<td>.402</td>
<td>-.163</td>
</tr>
<tr>
<td>IE/A3/20</td>
<td>.745</td>
<td>-.333</td>
<td>-.025</td>
<td>.37</td>
</tr>
<tr>
<td>IE/A3/30</td>
<td>.689</td>
<td>-.33</td>
<td>.076</td>
<td>.508</td>
</tr>
<tr>
<td>IE/B1/10</td>
<td>.669</td>
<td>-.024</td>
<td>.422</td>
<td>-.179</td>
</tr>
<tr>
<td>IE/B1/20</td>
<td>.791</td>
<td>-.231</td>
<td>-.171</td>
<td>-.269</td>
</tr>
<tr>
<td>IE/B1/30</td>
<td>.644</td>
<td>-.355</td>
<td>-.325</td>
<td>-.425</td>
</tr>
</tbody>
</table>

Note: IE=Intensity of Engagement; A1=Trail A1; A3=Trail A3; B1=Trail B1; 10= the initial ten seconds of a trial; 20=the second 10 second segment of a trial; 30=the third 10 second segment of a trial
Discussion of Table H.2

Based on this factor analysis and theoretical interpretation, the following composite affect variable was constructed, using standardized scores (i.e. Z-scores)

<table>
<thead>
<tr>
<th>Attention Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained Engagement</td>
<td>[(IE:A3:10-30)+(IE:B1:10-30)]</td>
</tr>
</tbody>
</table>

Note: IE=Intensity of Engagement; A1=Trial A1; A3=Trial A3; B1=Trial B1; 10= the initial ten seconds of a trial; 20=the second 10 second segment of a trial; 30=the third 10 second segment of a trial
Table H.3

Construction of Infant Social Variables, Factor Loadings

These eigenvalues were based on a principal components analysis on all trials (A1,A3,B1) for the first 3 ten second segments.

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Magnitude</th>
<th>Variance Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value 1</td>
<td>4.436</td>
<td>.164</td>
</tr>
<tr>
<td>Value 2</td>
<td>3.375</td>
<td>.125</td>
</tr>
<tr>
<td>Value 3</td>
<td>2.03</td>
<td>.075</td>
</tr>
<tr>
<td>Value 4</td>
<td>1.77</td>
<td>.066</td>
</tr>
<tr>
<td>Value 5</td>
<td>1.511</td>
<td>.056</td>
</tr>
<tr>
<td>Value 6</td>
<td>1.338</td>
<td>.05</td>
</tr>
<tr>
<td>Value 7</td>
<td>1.222</td>
<td>.045</td>
</tr>
<tr>
<td>Value 8</td>
<td>1.153</td>
<td>.043</td>
</tr>
<tr>
<td>Value 9</td>
<td>1.049</td>
<td>.039</td>
</tr>
<tr>
<td>Value 10</td>
<td>1.015</td>
<td>.038</td>
</tr>
<tr>
<td>Value 11</td>
<td>.974</td>
<td>.036</td>
</tr>
<tr>
<td>Value 12</td>
<td>.915</td>
<td>.034</td>
</tr>
<tr>
<td>Value 13</td>
<td>.716</td>
<td>.027</td>
</tr>
<tr>
<td>Value 14</td>
<td>.654</td>
<td>.024</td>
</tr>
</tbody>
</table>

By Scree Test, a 2 factor solution is adequate. Note the drop in the eigenvalue between two and three.
Unrotated Factor Matrix

<table>
<thead>
<tr>
<th>Social Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA/A1/10</td>
<td>.412</td>
<td>.299</td>
</tr>
<tr>
<td>SA/A1/20</td>
<td>.576</td>
<td>-.319</td>
</tr>
<tr>
<td>SA/A1/30</td>
<td>.397</td>
<td>.065</td>
</tr>
<tr>
<td>SA/A3/10</td>
<td>.43</td>
<td>.088</td>
</tr>
<tr>
<td>SA/A3/20</td>
<td>.568</td>
<td>-.225</td>
</tr>
<tr>
<td>SA/A3/30</td>
<td>.332</td>
<td>-.153</td>
</tr>
<tr>
<td>SA/B1/10</td>
<td>.318</td>
<td>.061</td>
</tr>
<tr>
<td>SA/B1/20</td>
<td>.479</td>
<td>-.108</td>
</tr>
<tr>
<td>SA/B1/30</td>
<td>.306</td>
<td>.115</td>
</tr>
<tr>
<td>SR/A1/10</td>
<td>.479</td>
<td>-2.44</td>
</tr>
<tr>
<td>SR/A1/20</td>
<td>.514</td>
<td>-.387</td>
</tr>
<tr>
<td>SR/A1/30</td>
<td>.235</td>
<td>-.331</td>
</tr>
<tr>
<td>SR/A3/10</td>
<td>.49</td>
<td>-.298</td>
</tr>
<tr>
<td>SR/A3/20</td>
<td>.561</td>
<td>-.417</td>
</tr>
<tr>
<td>SR/A3/30</td>
<td>.384</td>
<td>-.252</td>
</tr>
<tr>
<td>SR/B1/10</td>
<td>.399</td>
<td>-.383</td>
</tr>
<tr>
<td>SR/B1/20</td>
<td>.432</td>
<td>-.335</td>
</tr>
<tr>
<td>SR/B1/30</td>
<td>.258</td>
<td>-.222</td>
</tr>
<tr>
<td>SE/A1/10</td>
<td>.411</td>
<td>.629</td>
</tr>
<tr>
<td>SE/A1/20</td>
<td>.406</td>
<td>.304</td>
</tr>
<tr>
<td>SE/A1/30</td>
<td>.265</td>
<td>.462</td>
</tr>
<tr>
<td>SE/A3/10</td>
<td>.301</td>
<td>.652</td>
</tr>
<tr>
<td>SE/A3/20</td>
<td>.365</td>
<td>.428</td>
</tr>
<tr>
<td>SE/A3/30</td>
<td>.302</td>
<td>.089</td>
</tr>
<tr>
<td>SE/B1/10</td>
<td>.296</td>
<td>.593</td>
</tr>
<tr>
<td>SE/B1/20</td>
<td>.436</td>
<td>.49</td>
</tr>
<tr>
<td>SE/B1/30</td>
<td>.275</td>
<td>.454</td>
</tr>
</tbody>
</table>

Note: SA=Social Attention; SR=Social Referencing; SE=Social Enjoyment
A1=Trial A1; A3=Trial A3; B1=Trial B1; 10= the initial ten seconds of a trial;
20=the second 10 second segment of a trial; 30=the third 10 second segment of
a trial
Table H.4

Infant Co-regulation Factor Loadings

These eigenvalues were based on a principal components analysis on all trials (A1,A3,B1) for the first 3 ten second segments.

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Magnitude</th>
<th>Variance Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value 1</td>
<td>3.592</td>
<td>.399</td>
</tr>
<tr>
<td>Value 2</td>
<td>2.354</td>
<td>.262</td>
</tr>
<tr>
<td>Value 3</td>
<td>1.984</td>
<td>.22</td>
</tr>
<tr>
<td>Value 4</td>
<td>.927</td>
<td>.103</td>
</tr>
<tr>
<td>Value 5</td>
<td>.142</td>
<td>.016</td>
</tr>
</tbody>
</table>

Efficacy of Co-regulation is the only dyadic variable, therefore one factor was selected to represent it and make use of all codes.

Unrotated Factor Matrix

<table>
<thead>
<tr>
<th>Co-Regulation</th>
<th>Variable</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC/A1/10</td>
<td>.597</td>
<td></td>
</tr>
<tr>
<td>EC/A1/20</td>
<td>.632</td>
<td></td>
</tr>
<tr>
<td>EC/A1/30</td>
<td>.859</td>
<td></td>
</tr>
<tr>
<td>EC/A3/10</td>
<td>- .093</td>
<td></td>
</tr>
<tr>
<td>EC/A3/20</td>
<td>.199</td>
<td></td>
</tr>
<tr>
<td>EC/A3/30</td>
<td>.589</td>
<td></td>
</tr>
<tr>
<td>EC/B1/10</td>
<td>.305</td>
<td></td>
</tr>
<tr>
<td>EC/B1/20</td>
<td>.908</td>
<td></td>
</tr>
<tr>
<td>EC/B1/30</td>
<td>.886</td>
<td></td>
</tr>
</tbody>
</table>

Note: EC=Efficacy of Co-regulation; A1=Trial A1; A3=Trial A3; B1=Trial B1; 10=the initial ten seconds of a trial; 20=the second 10 second segment of a trial; 30=the third 10 second segment of a trial
Appendix I

Construction of Composite Preschool Regulation Variables

Table I.1

Preschool Regulation Affect Variables, Factor Loadings

<table>
<thead>
<tr>
<th>Affect Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect: TN</td>
<td>.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect: NT</td>
<td>.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect: PT</td>
<td>.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect: CT</td>
<td>.60</td>
<td>-.53</td>
<td></td>
</tr>
<tr>
<td>Negative-Anxious Affect: TN</td>
<td>-.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Anxious Affect: NT</td>
<td>-.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Anxious Affect: PT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Anxious Affect: CT</td>
<td></td>
<td>.84</td>
<td></td>
</tr>
<tr>
<td>Negative-Angry Affect: TN</td>
<td>.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Angry Affect: NT</td>
<td>.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Angry Affect: PT</td>
<td>.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-Angry Affect: CT</td>
<td>.92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: TN = Task Negotiation; NT = Novelty Trial; PT = Peak Trial; CT = Challenge Trial

All loadings >.40 are shown from the unrotated factor matrix (i.e. principal components analysis). This three factor solution is based on Eigenvalues >.10: F1=3.66; F2=2.87; F3=1.31. Factors 4 and 5 were borderline, and thus not included (1.0 and .94, respectively).
Discussion of Table I.1

Based on this factor analysis and theoretical interpretation, the following composite variables were constructed using standardized scores (i.e. Z-scores):

<table>
<thead>
<tr>
<th>Composite Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect - Novel</td>
<td>[((\text{PA}:\text{TN})+(\text{PA}:\text{NT})) - [(\text{NAA}:\text{TN}) (\text{NAA}:\text{NT})] ] ^a</td>
</tr>
<tr>
<td>Positive Affect - Challenge</td>
<td>[((\text{PA}:\text{CT})-(\text{NAA}:\text{CT}))]</td>
</tr>
<tr>
<td>Anger</td>
<td>[((\text{NAG}:\text{TN})+(\text{NAG}:\text{NT})+(\text{NAG}:\text{PT})+(\text{NAG}:\text{CT}))]</td>
</tr>
</tbody>
</table>

Note: \(\text{PA}=\text{Positive Affect; NAA=Negative-Anxious Affect; NAG=Negative-Angry Affect; TN = Task Negotiation; NT = Novelty Trial; PT = Peak Trial; CT = Challenge Trial}\)

^a \(\text{PA}:\text{PT} \text{ and NAA}:\text{NT} \text{ were excluded from this factor due to low loadings of NAA}:\text{PT} \ [.37] \text{ and to maintain interpretability of the composite as positive affect displayed during novel stress.}\)
Table 1.2

Preschool Regulation Social Variables, Factor Loadings

<table>
<thead>
<tr>
<th>Social Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPGS:TN</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>SPGS:NT</td>
<td>.67</td>
<td>.81</td>
</tr>
<tr>
<td>SPGS:PT</td>
<td>.81</td>
<td>.19</td>
</tr>
<tr>
<td>SPGS:CT</td>
<td></td>
<td>.82</td>
</tr>
<tr>
<td>S:TN</td>
<td>.89</td>
<td>.55</td>
</tr>
<tr>
<td>S:NT</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>S:PT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S:CT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: SPGS = Social Participation in Game Script; S = Sociability; TN = Task Negotiation; NT = Novelty Trial; PT = Peak Trial; CT = Challenge Trial

All loadings >.40 are shown from the orthogonal transformation with varimax, plus underlined loading <.40, which was included for theoretical reasons.

This two factor solution is based on eigenvalues of >1.00: F1=3.93; F2=1.54. Factors 3 and 4 are excluded, at .70 and .53 respectively.
Discussion of Table 1.2

Based on this factor analysis and theoretical interpretation, the following composite variables were constructed using standardized scores (i.e. Z-scores):

<table>
<thead>
<tr>
<th>Composite Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Novelty</td>
<td>([(\text{SPGS:TN})+(\text{SPGS:NT})+(\text{S:TN})+(\text{S:NT})])</td>
</tr>
<tr>
<td>Social Peak / Challenge</td>
<td>([(\text{SPGS:PT})+(\text{SPGS:CT})+(\text{S:PT})+(\text{S:CT})])</td>
</tr>
</tbody>
</table>

Note: SPGS = Social Participation in Game Script; S = Sociability; TN = Task Negotiation; NT = Novelty Trial; PT = Peak Trial; CT = Challenge Trial
Table 1.3

Preschool Regulation Attention Variables, Factor Loadings

<table>
<thead>
<tr>
<th>Attention Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE:TN</td>
<td>.79</td>
<td></td>
</tr>
<tr>
<td>IE:NT</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td>IE:PT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE:CT</td>
<td></td>
<td>.85</td>
</tr>
<tr>
<td>RPE:PT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPE:CT</td>
<td></td>
<td>.88</td>
</tr>
<tr>
<td>ESR:TN</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>ESR:NT</td>
<td>.85</td>
<td></td>
</tr>
<tr>
<td>ESR:PT</td>
<td>.54</td>
<td></td>
</tr>
<tr>
<td>ESR:CT</td>
<td></td>
<td>.78</td>
</tr>
</tbody>
</table>

Note: IE = Intensity of Engagement; RPE = Response to Perceived Error; ESR = Efficacy of Self-Regulation; TN = Task Negotiation; NT = Novelty Trial; PT = Peak Trial; CT = Challenge Trial

All loadings >.40 are shown from the orthogonal transformation with varimax.

This two factor solution is based on eigenvalues >1.00: F1=3.6; F2=1.89; F3=1.33, except that Factor 3 was excluded because it had only one significant factor loading (RPE:PT), and to maintain a smaller set of predictor variables for the multiple regressions.
Discussion of Table I.3

Based on this factor analysis and theoretical interpretation, the following composite variables were constructed using standardized scores (i.e. Z-scores):

<table>
<thead>
<tr>
<th>Attention Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention Challenge</td>
<td>[(IE:CT)+(RPE:CT)+(ESR:CT)]</td>
</tr>
</tbody>
</table>