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Understanding of self and maternal warmth predict later self-regulation in toddlers

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Research on the development of self-regulation has focused primarily on the roles of maternal behavior and attention, but cognitive understanding of the self is also likely to contribute, as is exposure to maternal depression. In this study toddlers' understanding of self-as-object and understanding of agency were assessed behaviorally at both 20 and 27 months ($N = 100$). Maternal warmth during interactions was also observed at both ages. Half of the toddlers had been exposed to maternal depression. At 34 months toddlers' self-regulation was assessed behaviorally. As expected, toddlers' early understanding of the self (both self-as-object and agency) as well as maternal warmth predicted self-regulation later in toddlerhood. Maternal depression, however, was not associated with self-regulation. These findings provide empirical support for the theoretical construct of the self-system and suggest that early cognitive understanding of the self enables toddlers to better regulate their behavior.

Keywords: early development; maternal depression; parenting; self-concept; self-regulation; toddlers

We examined early predictors of self-regulation in toddlerhood, testing a model of development that included both extra-individual processes as well as intra-individual processes. Or put in another way, we examined both parent and child influences on the development of self-regulation. Furthermore, potential moderator effects among predictors were examined. The two intra-individual processes examined were understanding of self-as-object and understanding of agency, and the extra-individual processes were maternal warmth and maternal depression.

Self regulation

Between the ages of one and three, children make great strides in self-regulation. They become increasingly adept at modulating their behavior according to the demands of situations so that goals can be met (Bullock & Lutkenhaus, 1988; Jennings, 2004). They better understand external standards for behavior and are more able to meet these standards (Kagan, 1981; Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; Kopp, 1982, 1991). Toddlers' success at self-regulating is important for their later adjustment. Early competence in self-regulation predicts better adaptive skills and fewer problem behaviors later in childhood (Eisenberg et al., 2004; Kochanska & Knaack, 2003).

Self regulation is a broad concept that focuses on efforts to modify behavior to reach goals (Demetriou, 2000; Eisenberg et al., 2004; Kochanska, Murray, & Harlan, 2000; Kopp & Wyer, 1994). Although authors occasionally use the term

broadly to include regulation of emotional states (e.g., Lengua, 2002) or emotion-related behavior (e.g., Eisenberg et al., 2004), more frequently the term refers to regulation of behaviors, or actions (e.g., Kopp & Wyer, 1994). The latter is the focus of the current paper. Self-regulation is a superordinate construct which includes more narrow constructs such as modulating visual attention, effortful control, and self-monitoring. Effortful control refers to the ability to suppress a dominant behavior in order to perform a subdominant one (Kochanska et al., 2000; Rothbart & Bates, 1998). We have elected to use the term self-regulation in this paper because successful performance of any task necessarily involves a variety of skills included under the rubric of self-regulation.

A better understanding of factors contributing to the development of self-regulation skills is needed. Clearly, both intra-individual processes (such as cognition and attention) and extra-individual processes (such as parenting) must be involved (Demetriou, 2000). Research to date has focused primarily on parenting (extra-individual) and to a lesser extent on attention (intra-individual). By examining a complex model, we hoped to develop a more realistic conceptualization of how self-regulation develops.

Intra-individual processes leading to self regulation

Among intra-individual processes that may contribute to developing self-regulation, control of visual attention has received the most empirical interest. Even young toddlers effectively use control of attention to regulate behavior (Kopp,

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1989; Ruff & Rothbart, 1996; Vaughn, Kopp, Krakow, Johnson, & Schwartz, 1986). Furthermore, attention control predicts later ability to self-regulate (Kochanska et al., 2000).

Changes in self concept have also been postulated to contribute to the emergence of self-regulation (Brownell & Kopp, 1991; Bullock & Lutkenhaus, 1990; Demetriou, 2000; Jennings, 1991, 1993; Kopp & Wyer, 1994; Lewis, 1991). Clearly regulating one's actions to meet goals or standards must require some knowledge of the physical self and abilities as well as some understanding of one's own and others' agency.

Early understanding of self-as-object and understanding of agency can facilitate the development of self-regulation through several pathways (Kagan, 1991; Stipek, Gralinski, & Kopp, 1990). One such pathway is through the earlier development of self-related emotional reactions when meeting, or failing to meet, goals or standards. As toddlers better understand the self-as-object, they experience pride when they successfully meet goals and guilt or shame when they fail (Lewis, Stanger, Sullivan, & Barone, 1991; Lewis, Sullivan, Stanger, & Weiss, 1989). Negative emotional reactions to transgressions occur only in toddlers who have developed a representation of the physical self (Kagan, 1991). Anticipation of these self-related emotional reactions should increase motivation to regulate behavior. A second pathway is through greater awareness of the connection between actions and goals. Understanding of agency should enhance awareness of how actions may facilitate (or hinder) the achievement of goals. This greater understanding should motivate toddlers to monitor and modulate their actions so that goals can be met, thereby encouraging regulation of one's actions. Thus together, understanding of self-as-object and understanding of agency should facilitate greater self-regulation.

Theoretically, self-as-object, agency, and self-regulation are all included in the overarching construct of the self-system (Demetriou, 2000; DesRosiers, Vrsalovic, Knauf, Vargas, & Busch-Rossnagel, 1999; Harter, 1998; Hymel & Moretti, 1999; Kopp & Wyer, 1994; Stipek et al., 1990). These and other components of the self-system develop in a systematic order (Courage & Howe, 2002), but considerable individual differences occur in the age of emergence of these skills, in part depending on parenting styles and sociocultural experiences (Keller et al., 2004). Despite the volume of theoretical work on the self-system, little is known about how different facets of the self-system relate to each other concurrently or how development in one facet may influence development in another facet (Keller et al., 2004; Lewis & Ramsay, 2004). This study addresses this gap. We hypothesized that both cognitive understanding of the self and understanding of agency would predict later self-regulation.

Extra-individual processes leading to self regulation

Parenting is probably the most important extra-individual process. A major goal of parents is to encourage self-regulation in their children. Parental warmth can enhance the development of self-regulation by making it more likely that children adopt parents' goals for their behavior as their own goals and by increasing motivation to meet these goals. Also the emotional responsiveness of warm parents to children's success can facilitate the development of children's own emotional reactions to meeting goals. Maternal warmth has been found to predict concurrent ability to self-regulate in toddlers (Calkins, Smith, Gill, & Johnson, 1998; Kochanska et

al., 2000; Volling, McElwain, Notaro, & Herrera, 2002) as well as future ability to self-regulate (Kochanska et al., 2000). Further, dyadic measures of the mother-child relationship that imply warmth and dyadic synchrony also relate to toddler's self-regulation, including shared positive affect (Gralinski & Kopp, 1993; Kochanska & Aksan, 1995), social contingency (Raver, 1996), and attachment security (Arend, Gove, & Sroufe, 1979; Kochanska, 1995).

Maternal depression is another extra-individual process that may affect the development of self-regulation. Depression in mothers is a common condition that can dampen warmth and increase negative interactions with toddlers (Cohn, Campbell, Matias, & Hopkins, 1990; Field, Healy, Goldstein, & Guthertz, 1990; Gotlib & Goodman, 1999). Furthermore the experience of depression is associated with low feelings of self-efficacy (Bandura, 1997; Barnett & Gotlib, 1988; Nolen-Hoeksema, Wolfson, Mumme, & Guskin, 1995; Weisz, Sweeney, Proffitt, & Carr, 1993). Thus depressed mothers are likely to model low persistence and low expectations for success. The combination of maternal depression and maternal negative expressivity has been associated with lower self-esteem in toddlers and more psychopathology (Goodman, Adamson, Riniti, & Cole, 1994).

We hypothesized that both maternal warmth and depression would predict toddlers' self-efficacy. We also expected that warmth would be negatively associated with depression.

Model

Our model was that both intra- and extra-individual processes enhance the development of toddlers' self-regulation; we expected that variables representing both processes would jointly predict self-regulation. In this study we tested a four variable model with two variables for each process. Understanding of self as object and understanding of agency represented intra- individual processes while maternal warmth and depression represented extra-individual processes. We also examined possible moderator effects of maternal warmth and depression on the relationship between understanding of self and self-regulation. Extra-individual processes (maternal warmth and depression) are likely to be more important in the development of self-regulation when intra-individual processes (understanding of self) are less advanced.

Method

Participants

Toddlers were seen with their mothers at 20 months ($M = 19.6$, $SD = 0.8$), 27 months ($M = 26.8$, $SD = 0.7$), and 34 months of age ($M = 34.0$, $SD = 0.7$). Of the 134 toddlers who began the study, 120 completed the assessment of self-regulation at 34 months and 100 had complete data on all summary measures in this paper. All toddlers were healthy and singleton-births.

To ensure meaningful differences in exposure to maternal depression, half of the mothers ($n = 50$) were recruited from a psychiatric facility. Mothers met criteria for the depressed group if they had (a) experienced an episode of depression since their toddler's birth (as determined by the Structured Clinical Interview for DSM-IV, SCID, see below) and (b) had sought treatment either when pregnant or after the toddler's

birth. Depressed mothers were recruited from several sources: a postpartum depression outpatient program ($n = 31$), a general outpatient program ($n = 4$), and posters describing the study that were placed within the larger psychiatry facility ($n = 11$). In addition, four mothers were initially recruited for the nondepressed group. The initial clinical pool contained 149 mothers who expressed interest in the study; 48% met criteria and agreed to participate, 26% did not meet criteria, and 26% declined to participate generally citing lack of time.

The remaining mothers in the final sample ($n = 50$) reported never having experienced an episode of depression (as determined by the SCID) nor had they experienced an episode of any other psychiatric disorder in the past 5 years. These nondepressed mothers were recruited from a large urban obstetrics hospital. The hospital sent mothers a letter describing the study, and interested mothers returned a postcard to us. Of the 148 mothers who returned a postcard and completed a preliminary telephone screening, 56% met criteria for the study and agreed to participate, 37% did not meet criteria (usually because the mother had been depressed sometime in her life but not since the birth of her toddler), and 7% declined to participate. Some mothers who met criteria were not included in the study because the two groups were matched on several demographic criteria including toddler gender, SES, ethnicity, marital status, and parity.

Sociodemographic characteristics are reported for the entire sample of 100 dyads because no differences were found between the depressed and nondepressed groups (reflecting successful matching). There were a few more boys ($n = 52$) than girls ($n = 48$). With regard to parity, 43 were first-born, 40 were second-born, 16 were third-born, and one was fourth-born; four of the first-born had younger siblings but none of the later-born. The majority of toddlers were European-American ($n = 91$), two were African-American, and seven were biracial. The families were predominantly middle-class (mean Hollingshead score = 1.9, $SD = 0.97$); however a range of socioeconomic (SES) levels was represented (1 to 4 from a possible range of 1 to 5). Eight mothers had only a high school education, 37 had some college or specialized training, 31 had graduated from college, and 24 had a graduate degree. All toddlers lived with their mothers. Most lived in two-parent families ($n = 88$), two lived with a step-father, six lived with other extended family members, and four lived only with their mother. The majority of mothers worked at least a few hours per week outside the house ($n = 58$). The number of hours that toddlers were in nonmaternal care (including care by fathers, babysitters, and daycare) varied considerably from zero to 60 hours per week, with 23 toddlers receiving nonmaternal care less than 6 hours and 32 toddlers receiving 40–60 hours per week. Comparing the 100 families with complete data to the 34 families with incomplete data, the only difference was that families with complete data had higher SES ($t = 2.98, p < .05$); no differences were found on maternal depression, parenting, or toddlers' understanding of self as object or agent

Procedure

Two visits were conducted at each age: first a home visit then an office playroom visit about one week later. In each home visit, mothers were interviewed about psychiatric symptoms and observed while playing with their toddler. In the playroom visit toddlers' understanding of self-concept was assessed at 20 and 27 months and self-regulation at 34 months. In addition,

at the 20 month home visit mothers provided information on family demographics and completed a questionnaire about the toddler's temperament. At the 20 month playroom visit toddlers were given the Bayley Scales of Infant Development, second edition (Bayley, 1993).

All sessions were videotaped and coded later by trained observers, who were blind to study hypotheses and family information. Interobserver reliability was established on at least 10 pilots prior to coding and assessed on 20% of participants during coding to prevent observer drift. Interobserver reliability was assessed by Kappas on categorical codes and by alphas on continuous codes.

Assessment of maternal depression

Mothers' depression status and psychiatric history were assessed with the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1995), a standard method for assessing depression in psychiatric research. The SCID is a standardized interview that takes approximately one hour and employs Research Diagnostic Criteria for DSM-IV to standardize diagnoses across research studies. Depression is an episodic disorder and its diagnosis requires that the person meet criteria for a Major Depressive Disorder (MDD) as outlined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994). Mothers were accepted into the study only after the initial SCID (at 20 months) indicated that they met criteria for either the depressed or nondepressed group. One mother was accepted into the study even though she had one symptom less than criteria for MDD because her symptoms were severe and included suicidality.

The SCID assesses symptoms for a wide range of psychiatric disorders. Participants are asked about current and past symptoms so that both a current diagnosis and a lifetime diagnosis can be made. In addition, symptoms during specific periods can be assessed. We asked mothers about depressive symptoms during the pregnancy and at six month intervals following the toddlers' birth. In addition to the presence versus absence of Major Depressive Disorder since the toddler's birth, several other measures of depression were derived. These secondary measures were: severity (number of depressive symptoms during the worst period of depression in the toddler's lifetime), chronicity (number of time periods in which the mother was depressed in the toddler's lifetime), comorbidity (number of other mental disorders in the toddler's lifetime), and recency of depressive symptoms (past month, past six months, prior to six months ago, or never). In addition, mothers completed the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) at the 20-month home visit. This is a widely used 21-item questionnaire that asks about depressive symptoms in the past two weeks.

Assessment of understanding of self-as-object

Understanding of self-as-object was assessed by three tasks at both 20 and 27 months (rouge task, photo task, and blanket task); a fourth task was added at 27 months (embarrassment task). The first three tasks have been widely used to assess toddlers' ability to recognize their physical attributes, and the embarrassment tasks are conceptually based on toddlers' ability to recognize the self as a separate entity. Coding for each task was dichotomous (pass/fail).

The rouge task (Bertenthal & Fischer, 1978; Lewis & Brooks-Gunn, 1979) consisted of surreptitiously wiping rouge on the toddler's nose and then placing the toddler in front of a mirror. The toddler was considered to have visual self-recognition if the toddler touched his or her nose or otherwise indicated that the rouge spot seen in the mirror was thought to be on the toddler's own nose. The mean Kappa over pairs of coders was .90. About two-thirds of toddlers (68%) showed self-recognition at 20 months and 88% at 27 months.

The photo task (Bullock & Lutkenhaus, 1990; Lewis & Brooks-Gunn, 1979) consisted of presenting the toddler three photographs, one of the toddler taken earlier in the session and two of other toddlers in the same setting. The three photos were placed in a 3-pocket plastic sleeve with the toddler's photo in the middle. The toddler was shown the photos and asked, "Where is [toddler's name]?" Toddlers were considered to have visual self-recognition if their first response was to point to their own photo. The mean Kappa over pairs of coders was .85. More than half (58%) showed self-recognition at 20 months and 78% at 27 months.

The blanket task (Bullock & Lutkenhaus, 1990; Geppert & Kuster, 1983; Piaget, 1954) consisted of first exposing part of an attractive picture of a bear that was under a mat and then sitting the toddler on the mat. The examiner then asked, "Where is the bear?" The toddler demonstrated an understanding of the self as an object with mass and weight by moving off the mat prior to attempting to retrieve the bear. If the toddler's response was ambiguous ($n = 26$ at 20 months and $n = 19$ at 27 months), a somewhat different version of the task was administered later in the session. In the second version the toddler was placed on a pillowcase with a colorful bear placemat inside. While turning down a corner of the pillowcase to expose part of the bear, the examiner said, "Look, there is something for you; get it out." The mean Kappa was .83. Most toddlers (77%) showed self-recognition at 20 months and 90% at 27 months.

The embarrassment tasks (Lewis et al., 1989) were added at 27 months because some toddlers had already passed all three tasks at 20 months. Although embarrassment tasks have not generally been used as a measure of understanding of self-as-object, embarrassment (a self-conscious emotion) emerges only after self-recognition is established (Lewis et al., 1989; Lewis et al., 1991). Thus embarrassment indicates a fuller understanding of the self-as-object. Three tasks were used to induce embarrassment: over-complimenting (lavishly complimenting the toddler's appearance in an overly effusive manner), dancing (coaxing the toddler to dance), and photo taking (asking the toddler to sit and smile so that a photo could be taken). On each task embarrassment was coded if the toddler showed at least two of the following three behaviors: smiled, avoided the examiner's gaze (e.g., hiding face or averting gaze, but then looking back within two seconds), or made nervous body movements (e.g., nervous touching of hair, face, or clothing). The mean Kappa was .80 for over-complimenting, .67 for dance, and 1.00 for photo taking. Because personality might make some toddlers more prone to feeling embarrassed, the presence or absence of any embarrassment response was used as the score rather than the number of embarrassment responses. The embarrassment tasks were much more difficult than the other tasks at 27 months: only 20% demonstrated embarrassment on any of the embarrassment tasks.

A summary measure of understanding of self-as-object was

formed from the mean of the standardized scores for the three tasks at 20 months and the four tasks at 27 months.

Assessment of understanding of agency

Pretend play has long been used as a window into toddlers' understanding of agency, both their own and others' (Brownell & Carriger, 1990; Kavanaugh, Eizenman, & Harris, 1997; Pipp-Siegel & Foltz, 1997). Toddlers' first efforts at pretend play are self-centered and only over time does their play include others who have independent agency (Brownell & Carriger, 1990; Fenson & Ramsay, 1980; Piaget, 1962; Watson & Fisher, 1977). We asked the toddler to repeat "stories," a series of simple actions with dolls and props (Brownell & Carriger, 1990). Each story corresponded to a different level of understanding of agency and each contained three actions. In the simplest story the self was the agent (eating breakfast). In the second level the self acts on another who is a passive recipient (putting a band aid on a doll). In the third level the other is an active agent (the doll grooms himself/herself). In the fourth level there are two active others (one doll puts the other to bed). In the fifth level the other has an internal state (the doll feels sick); this level was administered only at 27 months because prior work indicated that it was too difficult for 20-month-olds. The examiner demonstrated each story twice. For example in the simplest story, the examiner stated that she was eating breakfast and pretended to eat cereal from a bowl with a spoon, eat an apple, and drink juice from a cup. She then gave the props to the toddler, saying "Now it's your turn to tell the story." The score was the number of actions correctly imitated, with actions weighted by difficulty level (e.g., level one weighted by one and level five weighted by five). Because only four stories were given at 20 months, the maximum score was 30; whereas at 27 months the maximum was 45. No toddler approached the ceiling at either age. Mean percent-agreement was 94% at each age. The mean score was 12.5 ($SD = 3.9$) at 20 months and 25.8 ($SD = 6.3$) at 27 months.

Assessment of difficult temperament

Difficult temperament was assessed with the Child Characteristics Questionnaire, 24-month version (Lee & Bates, 1985). This measure assesses difficulty in regulating emotions and includes frequently crying, easily becoming upset, and difficulty calming. Difficult temperament predicts both internalizing and externalizing problems in later childhood (Bates, Bayles, Bennett, Ridge, & Brown, 1991).

Assessment of self-regulation

Self-regulation was assessed with four tasks from the work of Kochanska and colleagues (Kochanska et al., 1996). Kochanska's battery includes four delay tasks and one task for each of three other areas of self-regulation. Because of time constraints we included only a single delay task but all three other tasks. Only one minor change was made in administration or scoring as described below in the turtle and rabbit task.

The gift task assessed ability to delay. The examiner said that she was going to wrap a gift and then seated the toddler in a chair facing away from the gift-wrapping table. She told the toddler not to peek and gave reminders the first time the toddler turned around and 30 seconds into the 1-minute trial.

Four scores were derived. The peeking score was a rating scale (0 = turns around to peek and never returns to no-peeking position, 1 = turns around to peek but returns to no-peeking position, 2 = peeks over shoulder so can see wrapping, 3 = turns head but not enough to see wrapping, 4 = no attempt to peek). In addition, the latency to peek over the shoulder (in seconds) and the latency to turn around to peek were coded; toddlers who did not peek were given scores of 60 for latency. Finally, the total time peeking was coded. Kappa was .83 for the peeking score. Alphas were .94 for latency to peek over shoulder, .99 for latency to turn around to peek, and .97 for total time peeking. The mean peeking score was 1.6 ($SD = 1.5$); 24% of toddlers never turned around enough to see the wrapping while 32% turned around to view the wrapping and never returned to the no-peeking position. The mean latency to peek over the shoulder was 23.8 seconds ($SD = 24.5$), the mean latency to turn around was 35.9 seconds ($SD = 25.5$), and the mean time peeking was 17 seconds ($SD = 17.5$). These four scores were standardized (after reversing total time peeking) and summed to form a single score.

The whisper task assessed ability to modulate the voice. The toddler was shown 10 successive cartoon characters, such as Mickey Mouse, and asked to whisper each name. The examiner modeled the correct behavior by whispering while giving instructions. For each character, the toddler's response was coded (0 = shout, 1 = normal tone, 2 = mixed normal/whisper, 3 = no response, 4 = whisper). Alpha was .97. The score was the mean over all characters. The mean score over children was 3.3 ($SD = 0.9$).

The turtle and rabbit task assessed ability to modulate motor speed. The toddler was asked to help first a rabbit and then a turtle find their way home along a curved path. The examiner explained that the turtle was very slow and the rabbit was very fast (with exaggerated changes in voice speed to engage the toddler's attention and provide further cues for expected behavior). Three scores were derived. Accuracy in negotiating the path was coded from 1 (off path all the time) to 6 (on path all the time). Second, a slow-down score was the difference between the times of the turtle and rabbit trials. Because toddlers sometimes paused to correct their movements or engaged in extraneous behaviors that interfered with timing trials, we added a third measure, a rating of whether the toddler attempted to inhibit the speed of the turtle compared to that of the rabbit (1 = no inhibition, 2 = inhibition). Kappas were .81 for path accuracy and .78 for inhibition rating. The alpha for the slow down score was .96. The mean score for path accuracy was 3.8 ($SD = 0.9$), indicating that the figure was on the path more than half the time. The mean slow-down score was 2.0 seconds ($SD = 2.8$), indicating that the turtle took 2 seconds longer than the rabbit to navigate the path. Finally, 49% of toddlers were rated as inhibiting the speed of the turtle. The summary score for the turtle and rabbit task was formed in two steps. First the two scores assessing ability to inhibit speed were standardized and summed. Then this score and the measure of path accuracy were standardized and summed.

The tower task assessed suppressing and initiating an action to a signal. The toddler was asked to build a block tower together with the examiner with each taking turns. The examiner waited before placing each block until the toddler spontaneously signaled that it was the examiner's turn. Two trials were given. The score for each trial was the total number of blocks placed divided by the number placed by the toddler; this score was then multiplied by 10. The toddler was given an

extra 5 points for removing blocks carefully to prevent the tower from falling, and 5 points were taken away for knocking the tower over prematurely. For example, if the toddler placed 4 blocks and the examiner placed 4 on the tower, the total number of blocks placed was 8, which was divided by 4 (the number placed by the toddler); the result of 2 was then multiplied by 10 making a trial-score of 20. The task score was the mean of the two trials. Alpha was .84. The mean score was 17.1 ($SD = 2.8$).

A summary self-regulation score was formed by averaging the standardized summary scores for the four tasks. Chronbach's alpha was .53; Kochanska and colleagues (1996) reported an alpha of .75 on a similar battery (that contained three additional delay tasks). Dropping the least related task resulted in only a negligible increase in alpha (.54 instead of .53), and a principal components analysis indicated that the four tasks formed a single component. Therefore, we decided to retain all four tasks in the summary self-regulation score.

Assessment of maternal warmth

Warmth was assessed while mothers taught their toddler how to work a difficult toy (a shape sorter at 20 months and a cash register at 27 months). The task lasted five minutes and was videotaped. Maternal positive and a negative affect were rated every 30 seconds using a coding system based on that of Belsky, Youngblade, Rovine, and Volling (1991). Both scales ranged from (1) not at all positive (negative) to (4) very positive (negative). Affect was inferred from mothers' facial, vocal, gestural, and attentional behaviors. Positive behaviors included praise, encouragement, smiles, enthusiasm, affectionate touches, and other behaviors indicating acceptance of, enjoyment of, and sensitivity towards the toddler. Negative behaviors included negative tone of voice, anger, annoyance, frustration, aggressive touches, looking disinterested, and other behaviors indicating hostility, rejection, and/or unresponsiveness. Kappas ranged from .69 for negative behaviors at 20 months to .75 for positive behaviors at both 20 and 27 months. The mean score on each affect scale was computed for each mother. Positive behaviors occurred frequently (the mean score was 3.02 at 20 months and 2.87 at 27 months); in contrast, negative behaviors occurred very infrequently (the mean was 1.03 at 20 months and 1.02 at 27 months). A score of 1.00 for negative behavior indicated that no negative behavior occurred. A low level of maternal negative behavior is common when mothers are aware that they are being observed and consequently show more socially desirable behavior. Negative behaviors that occur under these circumstances are likely to be especially indicative of negative parenting. To make a single variable of maternal warmth at each age, the score for negative behavior was subtracted from the score for positive behavior. To keep the summary warmth score on the same 1 to 4 scale, 1.00 was first subtracted from the score for negative behaviors; thus, in the modal case of a score of 1.00 for negative behaviors, indicating that no negative behavior was observed, zero was subtracted from the score for positive behavior, leaving the score for positive behavior unchanged. The mean for the summary maternal warmth score at 20 months was 3.0 ($SD = 0.6$) and the mean at 27 months was 2.9 ($SD = 0.6$).

Results

Preliminary analyses

Developmental changes in understanding of self-as-object and agency. Table 1 shows descriptive statistics for the component variables used in the summary scores for understanding of self-as-object and for self-regulation. For self-as-object, performance significantly increased from 20 to 27 months for all three tasks: mirror ($t = 3.48, p < .001$), photo ($t = 3.19, p < .01$), and blanket t ($t = 2.25, p < .05$). These developmental changes are consistent with prior research (Bullock & Lutkenhaus, 1990; Keller et al., 2004; Lewis & Ramsay, 2004). In addition, scores for these tasks formed a Guttman scale such that toddlers who passed a task at 20 months also passed at 27 months and conversely those who failed at 27 months had also failed earlier at 20 months. Coefficients of reproducibility were .97 for the mirror task, .95 for the photo task, and .96 for the blanket task. Values above .90 signify a Guttman scale, indicating consistency in passing tasks across ages. Ability to understand agency also increased substantially from 20 to 27 months ($t = 22.47, p < .001$).

Control variables and correlations among variables. Table 2 shows descriptive statistics for all variables, including four control variables. SES was included as a control variable because it is known to relate to both parenting and toddlers' functioning. Bayley Mental Development Index (MDI) was included to ensure that any contribution of cognitive understanding of the self was independent of the level of general cognitive development. Toddlers' difficult temperament was included to control for early temperamental differences in emotion regulation on later behavioral self-regulation. Toddler gender was included because sometimes girls have been found to show greater self-regulation than boys. Table 3 shows the bivariate correlations among control and summary variables. Bayley MDI correlated with most independent variables and with the dependent variable, self-regulation. The other three control variables, on the other hand, showed minimal correlations with other variables.

Also of note in Table 3 is the stability of measures assessed at both 20 and 27 months. Understanding of agency showed some stability ($r = .40, p < .01$) but understanding of self-as-object did not ($r = .14, ns$). Removing embarrassment from the 27-month measure of understanding of self-as-object in order to make the two measures parallel did not improve stability ($r = .11, ns$). Likely, ceiling effects attenuated the correlation across time. Maternal warmth showed considerable stability ($r = .51, p < .001$). The two measures of cognitive understanding of self (i.e., self-as-object and agency) were related at 20 months ($r = .21, p < .05$) but not at 27 months ($r = .15, ns$). In general, the postulated predictors correlated with self-regulation with the exception of maternal depression.

Normality of distribution. Four variables showed statistically significant skew: understanding of self-as-object at both 20 and 27 months, maternal warmth at 20 months, and SES. Appropriate transformations were made to normalize the distributions of these variables. Analyses with transformed scores, however, were the same as those for untransformed scores. For simplicity, only results for the untransformed scores are presented.

Characteristics of depressed mothers. As a group the depressed mothers were clearly distressed and had significant depression. They reported experiencing a mean of 7.5 symptoms in their most severe episode since their toddler's birth. Five is the number of symptoms needed to meet criteria for depression and nine is the maximum possible. About one-third of mothers (36%) met criteria for depression in all three time periods in their toddler's life (0–6 months, 7–12 months, 13–20 months) whereas another third (38%) had depressive episodes during only one period. Depressive episodes were more common in the first 12 months of the toddlers' life with about one-third of mothers (38%) reporting remission by the time the toddler was 12 months old; conversely, 42% continued to have symptoms in the month prior to the initial assessment at 20 months. Furthermore, about one-third of depressed mothers met criteria for a second mental disorder since their toddler's birth, generally an anxiety disorder. On average depressed mothers had been in therapy for six months and had received medication for almost eight months since their toddler's birth. On the Beck Depression Inventory, which assessed symptoms in the past two weeks, depressed mothers had a mean of 11.4 ($SD = 8.8$) compared to 3.9 ($SD = 3.7$) for control mothers; scores of 10 to 18 are indicative of mild to moderate depression.

Hierarchical regression model predicting self-regulation

Hierarchical multiple regression was used to test our main hypothesis that both intra-individual and extra-individual processes would predict later self-regulation (see Table 4). The four control variables were entered at step 1. The extra-individual processes of maternal warmth and depression were entered at step 2 because prior research has documented the influence of maternal warmth on self-regulation. Finally, the intra-individual processes of understanding of self-as-object and understanding of agency were entered at step 3.

The overall regression equation with all variables entered was significant, $F(11,88) = 4.18, p < .001$. The full model explained 34% of the variance in self-regulation. The $R^2(.18)$ at step 1 was significant, indicating that as a group the four control variables significantly predicted self-regulation. However, none of the control variables had a significant Beta, although the Beta for Bayley MDI approached significance ($p < .10$). At step 2 the increase in $R^2(.06)$ did not reach standard levels of significance ($p < .10$), but the Beta for maternal warmth at 20 months was significant. Finally at step 3 a significant increase in $R^2(.11)$ was found as well as significant Betas for understanding of self-as-object at 20 months and understanding of agency at 20 months. These results confirmed our main hypothesis.

Further analyses examined whether using summary scores might be obscuring relations that would be better attributed to specific components. First the summary measure of understanding of self-as-object was examined by repeating the above regression equation with measures of individual tasks substituted for the summary measure (e.g., substituting mirror recognition for the summary measure). The final models for all four regression equations using the individual tasks were very similar to each other: the overall R^2 for the models ranged from .33 to .35 ($p < .001$) and the increase in R^2 was significant for steps 1 and 3 for all models. The similarity across models provided further support for combining the component

Table 1

Minimums, maximums, means, and standard deviations for the component variables for understanding of self-as-object and for self-regulation

<i>Variable</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>SD</i>
Understanding of self-as-object				
Rouge task: touch nose – 20 mo	0.00	1.00	0.68	0.47
Rouge task: touch nose – 27 mo	0.00	1.00	0.88	0.33
Photo task: point to self – 20 mo	0.00	1.00	0.58	0.50
Photo task: point to self – 27 mo	0.00	1.00	0.78	0.42
Blanket task: moves self – 20 mo	0.00	1.00	0.77	0.39
Blanket task: moves self – 27 mo	0.00	1.00	0.90	0.25
Embarrassment task: embarrassed – 27 mo	0.00	1.00	0.20	0.40
Self-regulation – 34 mo				
Gift: peeking strategy	0.00	4.00	1.59	1.50
Gift: latency peek shoulder	0.00	60.00	23.77	24.46
Gift: latency turn around	0.00	60.00	35.91	25.53
Gift: time peeking	0.00	60.00	17.00	17.50
Whisper: mean	0.90	4.00	3.25	0.92
Rabbit: path accuracy	1.33	5.67	3.80	0.91
Rabbit: slow down # seconds	-3.00	15.00	1.97	2.79
Rabbit: inhibition rating	0.00	1.00	0.49	0.50
Tower: mean score two trials	11.00	20.00	17.07	2.84

Table 2

Minimums, maximums, means, and standard deviations for summary and control variables

<i>Variable</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>SD</i>
Self-regulation	-1.2	1.2	0.1	0.6
Self-as-object understanding – 20 mo ^a	-1.7	0.8	0.0	0.7
Agency understanding – 20 mo	2.0	19.0	12.5	3.9
Self-as-object understanding – 27 mo ^a	-1.4	0.9	0.0	0.5
Agency understanding – 27 mo	8.0	40.0	25.8	6.3
Maternal warmth – 20 mo	1.1	4.0	3.0	0.6
Maternal warmth – 27 mo	1.4	4.0	2.9	0.6
SES	1.0	4.0	1.9	1.0
Bayley MDI	73.0	132.0	102.7	12.4
Difficult temperament	12.0	38.0	23.2	6.1

Note. ^a Means for self-understanding do not increase with age because component scores were standardized before adding.

Table 3

Intercorrelations of all variables

<i>Variable</i>	1	2	3	4	5	6	7	8	9	10	11
1. SES	—										
2. Bayley MDI	-.23*	—									
3. Difficult temperament	-.01	.07	—								
4. Toddler gender ^a	.09	-.07	-.10	—							
5. Maternal warmth – 20 mo	-.16	.18	.04	-.12	—						
6. Maternal warmth – 27 mo	-.10	.26*	-.02	-.05	.51**	—					
7. Maternal depression ^a	.01	-.10	.12	-.04	.09	-.11	—				
8. Self-as-object – 20 mo	-.09	.32**	.12	-.12	.22*	.27**	-.18	—			
9. Agency understanding – 20 mo	-.08	.45**	-.03	-.01	.04	.14	.05	.21*	—		
10. Self-as-object – 27 mo	-.15	.26*	-.01	-.14	.02	.16	.02	.14	.15	—	
11. Agency understanding – 27 mo	-.03	.33**	.13	-.07	.15	.21*	.10	.32**	.41**	.13	—
12. Self-regulation	-.17	.41**	.12	-.03	.28**	.13	.10	.35**	.39**	.13	.33**

Note. ^a For dichotomous variables, point-biserial correlations are shown.

* $p < .05$; ** $p < .01$.

Table 4

Summary of hierarchical regression analysis of maternal warmth and understanding of self-as-object and understanding of agency as predictors of self-regulation

Predictor(s) added at each step	β	B	SE B	ΔR^2
Step 1: $R^2 = .18$, $\Delta F = 5.17^{**}$				
SES	-.06	-.03	.05	.18**
Bayley MDI	.19 ^a	.01	.01	
Difficult temperament	.06	.01	.01	
Toddler gender	.04	.04	.10	
Step 2: $R^2 = .24$, $\Delta F = 2.34^a$				
Maternal warmth – 20 mo	.23*	.21	.10	.06 ^a
Maternal warmth – 27 mo	-.14	-.12	.10	
Maternal depression	.10	.11	.11	
Step 3: $R^2 = .34$, $\Delta F = 3.56^{**}$				
Self-as-object understanding – 20 mo	.21*	.17	.08	.11**
Agency understanding – 20 mo	.23*	.03	.02	
Self-as-object understanding – 27 mo	.02	.01	.10	
Agency understanding – 27 mo	.08	.01	.01	
Total R^2				.34
Final model				
<i>F</i>				4.18**
<i>df</i>				11, 88

^a $p < .10$; * $p < .05$; ** $p < .01$.

measures into a single summary measure of understanding of self-as-object.

In a similar manner, each of the four self-regulation tasks was examined separately to determine whether cognitive understanding of self (or maternal warmth) might be more important for certain aspects of self-regulation. The overall R^2 for the model was significant for three tasks and showed a trend on the gift task: rabbit and turtle task ($R^2 = .35$, $F(11,87) = 4.27$, $p < .001$), whisper task ($R^2 = .33$, $F(11,85) = 3.89$, $p < .001$), tower task ($R^2 = .20$, $F(11,86) = 2.01$, $p < .05$), and gift task ($R^2 = .17$, $F(11,87) = 1.67$, $p < .10$). The three significant models were for tasks that involved suppressing a dominant behavior in order to perform a subdominant one. In contrast, the task that required solely suppressing a dominant behavior (i.e., no peeking) showed only a trend towards significance. However, the standard errors for the four tasks overlapped indicating that the models were not significantly different from each other. In addition, combining scores across tasks provides a more robust measure. Thus we elected to continue the use of the summary measure for self-regulation, a decision that provides consistency with other empirical literature using Kochanska's measure.

Moderator effects

To examine whether maternal warmth or depression moderated the relation between toddlers' cognitive understanding of the self and self-regulation, scores were centered and an interaction term was added as a final step (step 4) to the regression model. To simplify analyses only the 20-month independent measures were used. A moderating effect was found only for maternal warmth on the relationship between understanding of agency and the development of self-regulation. The final model was significant, total $R^2 = .32$, $F(7,92) = 4.25$, $p < .001$ with significant increases in R^2 at steps 1, 2, 3, and 4. At step

4 when the moderation term was entered, the increase in R^2 was .04, $F(7,92) = 4.43$, $p < .05$. To interpret the interaction, simple slopes were calculated for the mean value of maternal warmth and for high and low levels of maternal warmth (plus or minus 1 *SD*, .62). These are graphed in Figure 1. Understanding of agency was associated with better self-regulation at low and medium levels of maternal warmth (slopes = .075 and .042, t 's = 3.86 and 2.97, $p < .01$) but not at high levels of maternal warmth (slope = -.010, $t = 0.36$, *ns*). Thus toddlers who had less understanding of agency later showed less self-regulation only if their mothers were less warm. Or to frame it differently, maternal warmth was more facilitative of later self-regulation in toddlers with less understanding of agency than in toddlers with more understanding of agency.

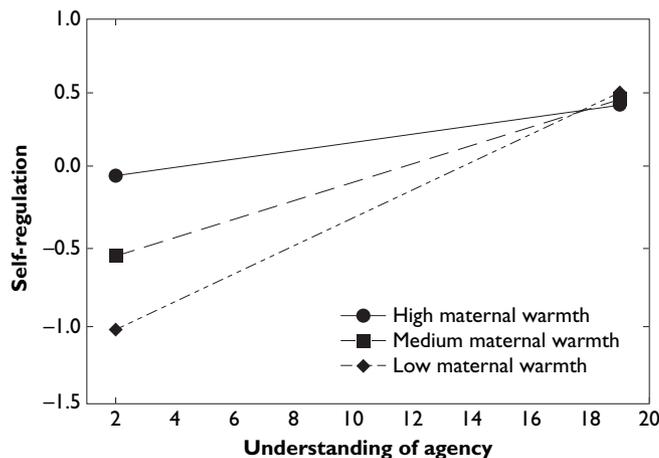


Figure 1. Interaction of maternal warmth and understanding of agency in predicting toddlers' self-regulation.

Post-hoc analysis of the relative contribution of 20- and 27-month measures

In the regression model (Table 4) significant Betas were found for all three 20-month predictors but none of the parallel 27-month predictors – suggesting that the 20-month measures might be better predictors. This was unexpected because typically measures that are closer in time relate more strongly than more distant measures. To determine whether the 20-month measures were significantly better predictors, two more regression models were calculated. After entering the control variables at step 1, the 27-month variables were entered at step 2 and the parallel 20-month variables at step 3. In the other model steps 2 and 3 were reversed. When the 27-month variables were entered first, step 2 was not significant ($\Delta R^2 = .04$, $\Delta F = 1.63$, *ns*), but step 3 was significant ($\Delta R^2 = .11$, $\Delta F = 5.10$, $p < .01$). When steps 2 and 3 were reversed, only step 2 (i.e., the 20-month variables) was significant, $\Delta R^2 = .13$, $\Delta F = 6.0$, $p < .001$). Thus, the 20-month variables added significant predictability even after accounting for the information provided in the 27-month variables.

A closer look at the possible role of maternal depression

Maternal depression status, as a present/absent variable, did not show the expected contribution to toddlers' self-regulation nor the expected relationship with maternal warmth. Nor was maternal depression playing a moderating role. To determine whether qualitative aspects of maternal depression, rather than simple present/absent, might be important, we conducted additional analyses using other measures of depression: the Beck Depression Inventory (BDI) as well as severity, chronicity, comorbidity, and recency of depression. However, further regression analyses indicated that none were significant predictors of self-regulation. Thus, maternal depression did not appear to play a role in the development of self-regulation in this sample.

Discussion

These results indicate that toddlers' understanding of self-as-object and understanding of agency as well as maternal warmth influence the development of self-regulation. Thus toddlers experience an advantage in the development of self-regulation when they develop an early understanding of self-as-object and understanding of agency in self and others. This advantage is over and above any advantage afforded by general level of cognitive development or less difficult temperament, as the latter were controlled along with SES and gender. Furthermore, maternal warmth seems more important for the development of self-regulation when toddlers have less understanding of agency. Thus, a model of the development of self-regulation that includes both intra-individual and extra-individual factors was supported.

More generally, the theoretical construct of the self-system was supported. Despite considerable theoretical writing on the self-system, empirical evidence documenting relations *between* components of the self-system is sparse. To be truly a system, components must relate to each other. Empirical evidence was found for relations among three components of the self-system. Cognitive understanding of the self-as-object and understanding of agency related to each other as well as to

self-regulation, with the exception of the 27-month measure of understanding of self-as-object.

Understanding of self-as-object and understanding of agency can facilitate later ability to self-regulate by several developmental pathways. Two possible pathways were discussed in the introduction: the earlier development of emotional reactions when meeting or failing to meet goals or standards, and greater awareness of the connection between actions and goals. Another pathway is enhanced meta-cognition of the self. In the second year of life, toddlers begin developing a meta-cognition of their actions, or a "hyper-cognitive" self-system in Demetriou's terms (2000). Once toddlers begin to recognize themselves and realize that they are a physical body in space like others (Lewis & Brooks-Gunn, 1979), they become increasingly aware of themselves as the source of their actions and more aware of how their actions affect objects and other people (Pipp-Siegel & Foltz, 1997). This increased self-awareness, or meta-cognition, of their actions should enable toddlers to better monitor and modulate their actions so that goals are attained. Another developmental pathway is through increased motivation to meet external standards for their actions and the greater internalization of standards. Greater awareness of themselves as an object whose actions can be evaluated by others should motivate toddlers to discern or seek out external standards for their actions. Thus toddlers should more readily adopt external goals and standards as their own. As these goals and standards are internalized, motivation for regulating actions should increase. Thus the developing self-system can encourage greater self-regulation through both cognitive and motivational changes.

The importance of parenting in developing self-regulation was also confirmed by the results of this study. Toddlers with mothers who were warmer during teaching interactions demonstrated greater self-regulation more than a year later. This finding is consistent with prior research. Kochanska, Kopp and others have proposed that toddlers who experience warm mothering are more likely to adopt the standards and expectations of their mothers as their own and thus are more motivated to regulate their behavior in order to meet these goals and expectations (Kochanska & Aksan, 1995; Kopp, 1991). The greater internalization of standards, in turn, provides the toddler with more occasions to practice regulating behavior. Furthermore, mothers with a warm interactional style are more likely to praise and scaffold their toddlers' efforts to regulate their behavior thus enhancing the development of self-regulation.

The role of maternal warmth in facilitating the development of self-regulation is less important among toddlers with greater understanding of agency. That is, toddlers with a better understanding of agency have less need of maternal warmth in order to learn to regulate their behavior. This finding may indicate alternative pathways to self-regulation through internalization of standards. Toddlers with a more developed meta-cognition of the self are more aware of goals and standards as well as the actions required to meet them. Among toddlers with a less well-developed meta-cognition of self, maternal warmth may enable toddlers to adopt their mothers' standards because of greater attunement with their mothers. In addition, these toddlers may benefit more from their warm mothers' efforts to teach regulating skills.

Contrary to expectations, maternal depression did not relate to toddlers' self-regulation, nor did it show the expected relation with maternal warmth that has been found in other

studies. Our findings agree with other research showing that maternal depression is not related to self-recognition in toddlers (Cicchetti, Rogosch, Toth, & Spagnola, 1997), but we had anticipated maternal depression to relate to maternal warmth and toddlers' self-regulation. Possibly the depressed mothers in our sample were less stressed than some other samples because most were middle-income and few were from lower (more stressed) socioeconomic groups. Seifer (1995) and others have argued that families may be able to cope with a single stressor and that negative effects are more likely with multiple stressors. Another possibility is that the willingness of the depressed mothers in our sample to seek and engage in treatment may indicate a coping that is not present in depressed mothers from community samples. Despite treatment, the level of depression of mothers in our study was not trivial. Almost half were continuing to have depressive symptoms when their toddlers were 20 months, and 12 percent (6 of 50) had been hospitalized. The lack of relationship of maternal depression with toddlers' self-regulation does not preclude a relationship with psychopathology in young children, including externalizing disorders as has been found in other studies (e.g., Chang, Lansford, Schwartz, & Farver, 2004; Goodman et al., 1994).

A surprising finding was that the earlier measures of cognitive understanding of self and maternal warmth predicted self-regulation better than later measures. Typically measures that are closer in time relate more strongly than measures that are further apart in time. Nonetheless the 20-month measures of understanding of self-as-object and agency, as well as maternal warmth, predicted self-regulation at 34 months better than the parallel 27-month measures. Even when the 27-month measures were added to the regression model prior to the 20-month measures, the 27-month measures did not add any predictive power beyond the control variables. Perhaps 20 months is an especially good age to assess self-processes. Ruff & Rothbart (1996) describe the 18–24 month period as an important transition period in which self-regulation first emerges. Jennings (1991, 1993) also discusses the focus on outcome that develops at this age, which enhances investment in agency and an emerging view of the self as either competent or incompetent. Possibly younger toddlers with a better cognitive understanding of the self are more able to cope with early demands for self-regulation, which set the stage for continued competence in this area. Similarly, maternal warmth may be especially important in the 18–24 month period when self-regulation is just beginning to emerge.

In summary, both cognitive understanding of the self and maternal warmth appear to contribute to the development of self-regulation. However, alternative explanations cannot be ruled out. We controlled for difficult temperament but other temperamental or genetic factors in the toddler may affect the development of all three variables of interest: cognitive understanding of the self, self-regulation, and maternal behavior. Alternatively, parenting behaviors, such as warmth, that facilitate the development of self-regulation may also facilitate the earlier development of cognitive understanding of self, although recent work by Keller et al. (2004) would argue against this possibility. The current study also has some methodological limitations. First, the 27-month measure of understanding of self-as-object may be inadequate as ceiling effects were evident for three of the four tasks. Also the summary measure lacked concurrent and predictive validity; that is, it did not relate to the Bayley MDI nor to the earlier

measure of self-as-object. Another limitation was that stability was low (but statistically significant) for understanding of agency from 20 to 27 months. There are probably inherent limitations in finding internal consistency and reliability in the behavior of young toddlers, but hopefully future research can develop more internally consistent measures. In addition, future research should include toddlers from non-Western cultural backgrounds given substantial cultural differences in child-rearing practices, e.g., Ho (1986), Li-Grining (2007), and Yen, Robins, & Lin (2000).

In conclusion, early cognitive understanding of the self, specifically self-as-object and agency, facilitates later ability to self-regulate. Indeed, it can be said that in toddlerhood a coherent self-system begins to emerge. Toddlers who earlier show greater understanding of themselves as objects in the world and a greater understanding of themselves and others as intentional agents later better regulate their behavior to attain goals. Warm maternal interactions in the second year of life also contribute to later ability to self-regulate and seem to be especially important for toddlers with less understanding of agency. Thus both intra-individual and extra-individual influences contribute to the ability to self-regulate as the toddler period ends.

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