Cognitive and emotional aspects of self-regulation in preschoolers

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Abstract

The goal of the present study was to examine the contribution of executive function (EF) and social cognition to individual differences in emotion regulation (ER) in preschool children. Sixty 3-, 4-, and 5-year-old children were administered a battery of EF tasks, two theory of mind tasks, a measure of verbal ability, and an ER task. In addition, parents completed the Behavior Rating Inventory of Executive Functioning—Preschool Version (BRIEF-P). Performance on the theory of mind tasks as well as parental ratings of executive function was not related to performance on the ER task. However, a component of EF (i.e., inhibition) approached significance with children’s displays of positive behaviors during the ER task. Verbal ability was related to the regulation of positive but not negative emotions. Parental ratings of shifting accounted for a significant amount of variance in parental ratings of ER, even after controlling for verbal ability. The findings are discussed in the context of different conceptualizations of the developmental relation between ER and EF.

Keywords: Executive function (EF); Emotion regulation (ER); BRIEF-P; Theory of Mind (ToM)

1. Introduction

Self-regulation has been considered a “central and significant developmental hallmark of the early childhood period” (Bronson, 2000, p. 32), and it has emerged as the single most important predictor of resilience in at-risk children even after controlling for a variety of other variables (Buckner, Mezzacappa, & Beardslee, 2003). Self-regulation is a complex concept that includes processes that are involved in the regulation of emotions, motivation, cognition (e.g., attention), social interactions, and physical behavior (Karoly, 1993). According to Bodrova and Leong (2006), the processes involved in self-regulation can be divided into two broad classes: social–emotional and cognitive self-regulation. The former makes it possible for children to conform to social rules...
and to benefit in various social contexts, while the later allows children to use cognitive processes necessary for problem solving and related abilities (Bodrova & Leong, 2006).

Recently, the development of different aspects of self-regulation and their developmental relations has received considerable attention. Specifically, several studies have examined the developmental relations between executive function (EF), which is considered an important aspect of cognitive self-regulation (Bodrova & Leong, 2006), and social cognition (theory of mind [ToM]). However, little is known about the developmental relations between EF and social cognition, or between EF and emotion regulation (ER). Furthermore, the extent to which language mediates the relations between EF, social cognition, and ER has received little attention. Thus, the major goal of the present study was to examine the relations between EF, social cognition, and ER in preschool children, and to investigate the influence of language on these relations.

In the following sections, we first discuss findings on the system of EF and its development. This is followed by a description of ToM as well as a brief overview of the links between EF and ToM. Next, ER is discussed followed by an overview of the relation between EF and ER. The role of language in the development of EF and ToM is then introduced. Finally, the goals of the study are summarized.

1.1. Executive function

Executive function is an umbrella term that generally refers to the mental operations involved in the conscious control of thoughts and actions (Baddeley, 1996; Perner & Lang, 1999; Stuss & Knight, 2002; Zelazo & Müller, 2002). Although some researchers consider EF as a unitary process (e.g., Kimberg, D’Esposito, & Farrah, 1997), recent factor analytic studies of EF in adults (e.g., Ettenhofer, Hambrick, & Abeles, 2006; Fisk & Sharp, 2004; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000), and children (e.g., Brocki & Bohlin, 2004; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; St Clair-Thompson & Gathercole, 2006) suggest that EF is multidimensional and includes, among others, the processes of shifting, updating, and inhibiting. Shifting, or “attention switching,” refers to the ability to change back and forth between multiple tasks, mental sets, and operations (Miyake et al., 2000; Monsell, 1996). Updating refers to the updating and monitoring of representations held in working memory (WM). These processes involve the monitoring and coding of incoming information that is relevant to the task at hand, followed by the revision of items held in WM and a replacement of old irrelevant information with new relevant information (Miyake et al., 2000; Morris & Jones, 1990). Inhibition is the ability to suppress dominant, automatic, or prepotent responses. The present study will adopt a multi-dimensional approach, assessing shifting, WM, and inhibition as components of EF.

Though a few studies have used naturalistic observations to examine the contribution of EF to children’s social competence (e.g., Peskin & Ardino, 2003) and problem behaviors (e.g., Fahie & Symons, 2003), limited research has assessed EF in terms of children’s everyday behaviors. Indeed, the exclusive use of performance-based measures of executive function has been criticized as being too narrow and failing to accurately capture children’s “real-world” functioning (Bodnar, Prahme, Cutting, Denckla, & Mahone, 2007). The concomitant use of parent and teacher reports of children’s everyday behaviors may add to the ecological validity of EF assessments.

The Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) was developed for this purpose—to further understand children’s and
adolescents’ (i.e., 5–18-year olds) executive function competence in a real-world setting (Baron, 2000). The BRIEF samples children’s behaviors thought to be related to everyday executive skills in natural settings by having parents and/or teachers complete a rating scale containing statements about the child’s daily life. Studies conducted with the BRIEF have demonstrated that it “captures profiles” of EF that differ across various disorders including Attention-Deficit Hyperactivity Disorder and Autism Spectrum Disorder (Gioia, Isquith, Kenworthy, & Barton, 2002). In 2003, Gioia, Espy, and Isquith (2003) developed a preschool version of the BRIEF (BRIEF-P). The new behavior rating scale consists of five scales: inhibit, shift, emotional control, working memory, and plan/organize.

1.2. Theory of mind and executive function

The term **theory of mind** refers to children’s ability to attribute various mental states to themselves and to others (Astington, 1993). ToM understanding is attributed to children who are able to use knowledge of their own and others’ mental states to understand others’ behavior (Carlson, Moses, & Claxton, 2004). An important transition in ToM understanding occurs between 3 and 5 years of age when children begin to comprehend that they themselves, as well as other people, can hold and act on false beliefs (Astington, 1993; Perner, 1991; Wellman, Cross, & Watson, 2001).

The finding that EF and ToM abilities both undergo important developmental changes between the ages of 3 and 5 years provided a theoretical impetus for the investigation of relations between the two constructs. Research suggests that there is a functional relation between EF and ToM because performance on EF and ToM tasks has been found to be significantly correlated in typically (e.g., Carlson & Moses, 2001; Carlson, Moses, & Breton, 2002; Perner & Lang, 1999) and atypically developing children (e.g., Colvert, Custance, & Swettenham, 2002; Ozonoff et al., 1991; Zelazo, Jacques, Burack, & Frye, 2002), even after controlling for age, verbal ability, and IQ. Though there is strong empirical evidence for a functional link between ToM and EF, the direction of causality remains unclear. The empirical relation has been interpreted differently, with some researchers suggesting that ToM is a prerequisite for EF (e.g., Perner & Lang, 1999), while others argue that EF is a prerequisite for ToM (e.g., Hughes, 1996; Russell, 1996).

1.3. Emotion regulation

ER, broadly defined, refers to the psychological processes involved in the control of emotion. In his comprehensive definition, Thompson (1994, pp. 27–28) defines ER as “the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one’s goals.” ER is conceptualized as an integral part of self-regulation, and deficits in ER have shown to be linked to internalizing and externalizing disorders (Calkins & Howse, 2004).

A paradigm frequently used to assess ER skills in preschoolers is the structured disappointment procedure in which children received an unwanted gift (Cole, 1986; Saarni, 1984). The disappointment procedure presents the child with a conflict. On the one hand, social norms dictate that one must smile and express appreciation when receiving a gift, and on the other hand the child feels genuine disappointment as a result of receiving an undesired gift (Kieras, Tobin, Graziano, & Rothbart, 2005). How children resolve this conflict can be used to gauge their ER abilities.
1.4. Emotion regulation and EF

Two recent studies have shown that ER and EF are related. Hoeksma, Oosterlaan, and Schipper (2004) found a correlation between variability of anger and response inhibition in children between the ages of 10 and 13 years. Using a motor inhibition task as an indicator of effortful control, Kieras et al. (2005) found that children’s effortful control was significantly related to their display of positive affect in the disappointment procedure. Specifically, children with low effortful control showed less positive affect after receiving an undesirable gift than after receiving a desirable one. By contrast, the amount of positive affect displayed by children with high effortful control did not differ across these situations. Taken together, these findings suggest that inhibition is involved in ER. However, because extant studies have not assessed whether other aspects of EF, in addition to inhibition, contribute to ER, the unique contribution of each aspect of EF to ER remains unclear. The present study will elucidate the relation between different aspects of EF and ER by jointly assessing all three components of EF and determining their relative contribution to individual differences in ER.

1.5. The role of language

Studies which assessed the correlation between language and EF in preschoolers have generally found correlations between measures of EF and verbal ability in 2-year olds (Carlson et al., 2004; Hughes & Ensor, 2005) as well as in older preschool children (Blair, 2003; Carlson et al., 2004; Müller, Zelazo, & Imrisek, 2005). Particularly striking are the high correlations between verbal ability and tasks assessing cognitive flexibility (Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Lang & Perner, 2002; Müller et al., 2005; Perner, Lang, & Kloo, 2002), and complex working memory (Davis & Pratt, 1995; Keenan, 1998).

A clear link has also been established between verbal ability and theory of mind performance in children (e.g., Astington & Jenkins, 1999; Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003). Taken together, all of these findings support the notion that language and control processes are associated. What remains unclear is whether and to what extent verbal ability mediates the relation between, on the one hand, EF and social understanding, and, on the other hand, ER.

1.6. Goals of the study

To summarize, the major goals of the present study were: (a) to examine the relation between measures of ER, EF, and ToM, including both performance-based measures and parent ratings, and (b) to assess the role of language in the relation between ER, EF, and ToM. We examined relations between children’s performance on a battery of EF tasks, the Behavior Rating Inventory of Executive Function—Preschool Version (BRIEF-P), two measures of social cognition (i.e., ToM), the Peabody Picture Vocabulary Test (PPVT-3; Dunn & Dunn, 1997), and a performance-based measure of ER.

2. Method

2.1. Participants

Sixty-four children were initially tested, however, four children were not included in the final sample (mean age = 54 months) because of refusal to complete all stages of testing (n = 2),
uncertainties regarding normative development \((n = 1)\), or insufficient command of the English language \((n = 1)\). The remaining 60 children were between the ages of 37 and 70 months (23 boys and 37 girls, \(M = 52.55\) months, S.D. = 8.16) and were divided into two age groups: younger preschoolers (14 boys and 16 girls, \(M = 45.47\), S.D. = 3.82) and older preschoolers (9 boys and 21 girls, \(M = 59.63\), S.D. = 4.16). Children were recruited from various daycares in a medium sized Canadian city and received gifts for participating in the study.

A parent provided ratings for each of the children on the BRIEF-P, with the exception of two parents who did not provide ratings. The majority of parents who responded (98%) were the mothers of the participants.

2.2. Procedures

All participants were tested individually by a female experimenter at their daycare or preschool and all sessions were videotaped. The tasks were presented in a fixed order as this is preferable to counterbalancing when investigating individual differences and correlations between variables (see Carlson & Moses, 2001, for a justification): intradimensional/extradimensional shifting, Backward Digit Span, gift delay, Peabody Picture Vocabulary Test (Dunn & Dunn, 1997), and the disappointment procedure.\(^1\) The ToM measures were administered during breaks in the disappointment procedure. The BRIEF-P (Gioia et al., 2003) was distributed to a parent on the day each child was tested, and was returned to the experimenter shortly thereafter.\(^2\),\(^3\)

2.2.1. Measure of emotional control

2.2.1.1. Disappointment procedure. Participants were asked to rank eight small prizes for their desirability. Among the eight gifts were some undesirable toys, including items that were visibly broken (e.g., twisted slinky) as well as toys most children found desirable (e.g., a toy car). After children completed their rankings, the experimenter placed the gifts out of the participant’s view and administered a task unrelated to the disappointment task (i.e., contents false belief for self). Upon completion of this task, the experimenter told the participant he or she would be awarded a gift and presented the participant with his or her first choice toy in a gift bag. The child was allowed to open and explore the gift for 20 s while the experimenter maintained regular eye contact and a neutral facial expression as she gathered her papers. Verbalizations by the child were paraphrased in a neutral tone by the experimenter. A second task unrelated to the disappointment task (i.e., contents false belief for other) was then administered. Following this false belief task, the experimenter presented the child with the same gift bag; however this time it contained his or her last choice toy. As with the first gift, the experimenter remained neutral for 20 s and then exclaimed that a mistake had been made and that the participant had received the wrong toy. The child was offered another toy in exchange for the mistaken gift, and a brief explanation was offered for the deception of the task.

Based on previous coding schemes developed for this paradigm (e.g., Saarni, 1984), facial action, gestures, and vocal cues were used as indicators of the presence of both positive and negative emotions (see Appendix A). Two trained coders continuously coded each child on a

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\(^1\) Three other tasks were administered to children as part of a separate line of research.

\(^2\) The BRIEF-P was also completed by the primary caregiver of each child at their daycare or preschool; data pertinent to caregiver ratings will be reported elsewhere.

\(^3\) For the purpose of the present study, only four of the scales of the BRIEF-P were examined: shifting, working memory, inhibition, and emotional control.
second-by-second basis for the two gift segments. Observation was terminated if the child’s behavior indicated a loss of interest in the task or after 20 s.

2.2.2. Executive function battery

2.2.2.1. Measure of inhibition. Gift delay. Participants were told they would receive a gift (e.g., a small toy ball) and were asked to sit in a chair facing away from the experimenter and not to look while the present was wrapped so that it could be a “big surprise.” The experimenter wrapped the present noisily for 60 s. Participants’ score reflected the latency to peek over the shoulder (0–60 s).

2.2.2.2. Measure of shifting. Intradimensional/extradimensional (ID/ED) shift. The task used in the present study was adapted for use with young children based on the ID/ED shift task in the Cambridge Neuropsychological Test Automated Battery (CANTAB; Fray, Robbins, & Sahakian, 1996). The task involved three sets of stimuli consisting of picture items that differed in color and pattern. Stimuli were presented in four phases: compound discrimination, compound reversal, intradimensional (ID) shift, and extradimensional (ED) shift. Both compound phases consisted of a maximum of 75 trials with the same set of stimuli. The ID and ED phases each had the same number of maximum trials, but stimuli in the ID and ED phases differed from those used in the other phases and from each other, as described below.

Participants were presented with two pictures on a page that differed in color and pattern, and were asked to select the one that was “correct.” Participants were informed that they had to determine which picture was correct on their own, but the experimenter would provide feedback. The experimenter responded with “yes” when the participant was correct and with “no” if the participant had chosen the wrong picture. Participants were told that the pictures were different shapes and different colors and that a rule could be followed to make the right choices. They were told that “sometimes that rule will change and you have to be ready for this, but the change won’t happen very often.”

The order of the four phases always remained constant: compound discrimination, compound reversal, ID, and ED. In the compound discrimination phase two pictures were presented that differed in color and pattern, and positive feedback was given for either selecting a particular color or pattern. In the compound reversal phase the feedback provided was reversed so that the dimension (i.e., color or pattern) that was correct in the discrimination phase was now incorrect, and the dimension that was previously incorrect was now correct. In the ID phase, a new exemplar for each dimension was introduced, and participants were required to continue to respond to the previously relevant dimension. The ED phase involved the introduction to another set of exemplars and participants were required to shift their responses to the previously (i.e., in the ID phase) irrelevant dimension to perform correctly. A switch to the new phase was never announced by the experimenter. For each of the four phases, participants who made 6 consecutive correct responses (out of the maximum of 75) were considered to have passed. Participants’ score was calculated as the proportion of perseverative errors for the ED phase.

2.2.2.3. Measure of working memory. Backward Digit Span. The experimenter used a puppet to demonstrate how to say digits backwards. The experimenter said “We are going to play a silly game with Molly, so whatever she says, I will say it backwards. Let me show you how to play. If Molly says the numbers ‘1,2’ then I will say ‘2,1.’” Participants were asked to do what the experimenter had done. A two-digit practice trial was administered, in which participants were corrected if they were wrong, and the example provided was repeated. If the participant did not
answer correctly after two repetitions of the rules, the game ended. The series size of the test trials increased with every successful trial (from 2 to 4 digits), with the highest level achieved being recorded as the participant’s score (1–4). Participants who failed the two-digit series were given a score of 0.

2.2.3. Peabody Picture and Vocabulary Test (Dunn & Dunn, 1997)  
The PPVT-3 correlates highly with full-scale verbal intelligence measures such as the Wechsler Preschool and Primary Scales of Intelligence—Revised (WPPSI-R) (Carvajal, Parks, Logan, & Page, 1992) and the verbal subscale of the Stanford–Binet IV (Hodapp, 1993). The experimenter read aloud a word, and children were asked to select the picture that best illustrated what the word referred to among a set of four pictures. The task continued until children had reached an error rate of 75% on the last 12 words.

2.2.4. Measures of theory of mind

2.2.4.1. Contents false belief for self (representational change). Following the procedures of Gopnik and Astington (1988) and Carlson and Moses (2001), participants were shown a Play-Doh box and asked, “What do you think is in this box?” The experimenter revealed there were tissues inside the box, and then asked, “What did you think was inside this box when you first saw it?” If the participant did not answer, he/she was prompted with, “What did you think was inside this box when you first saw it? Play-Doh or tissues?” Next, the participant was asked, “What do you now think is inside this box?” Again, if the participant did not answer, he/she was prompted with, “What do you now think is inside this box? Play-Doh or tissues?”

2.2.4.2. Contents false belief for other. The experimenter introduced a doll and told the participant that the doll would be shown a box and asked questions about it. The participant was shown a crayon box and the experimenter asked, “[Doll], what do you think is inside this box?” The experimenter had [Doll] say, “Crayons.” The box was opened and the experimenter revealed that there were stickers inside. After the box was closed, the participant was asked, “Now let’s imagine that [Doll] comes into the room and sees this box for the very first time. What would [Doll] think is inside this box?” If the participant did not answer, he/she was prompted with, “What would [Doll] think is inside this box if he saw it now for the very first time? Crayons or stickers?” Next, the participant was asked, “What does [Doll] now think is inside this box?” Again, if the participant did not answer, he/she was prompted with, “What does [Doll] now think is inside this box? Crayons or stickers?”

2.2.5. BRIEF-P  
The BRIEF-P (Gioia et al., 2003), was derived from the original BRIEF (Gioia et al., 2000), and consists of 63 items that make up the 5 scales described below. The manual for the BRIEF-P provides details regarding the reliability, validity, and data from a normative sample.

2.2.5.1. Emotional control. This dimension measures a child’s ability to modulate his or her emotional responses. Examples of BRIEF-P items related to emotional control are “Becomes upset too easily” and “Mood changes frequently.”

2.2.5.2. Inhibit. This dimension measures the child’s ability to resist responding or acting on an impulse (i.e., inhibit) and to stop his or her behavior at the appropriate time. Items on the
BRIEF-P related to inhibition include such items as “Is impulsive” and “Acts too wild or out of control.”

2.2.5.3. Shift. This dimension measures a child’s ability to move from one situation to another (e.g., from one aspect of a problem to another) as is required by the current conditions. BRIEF-P items include “Is upset by change in plans or routines,” “Becomes upset with new situations,” and “Has trouble with activities that involve more than one step.”

2.2.5.4. Working memory. This dimension measures the child’s ability to hold information in his or her mind for the purpose of completing a particular task. BRIEF-P items related to WM include “Cannot stay on the same topic when talking” and “Has trouble remembering something, even after a brief period of time.” WM on the BRIEF-P incorporates both the abilities to sustain attention and performance.

3. Results

The results are presented in four parts. First, descriptive information about the disappointment procedure is provided to determine whether this procedure evoked ER. Second, developmental trends on performance-based measures are examined. Third, correlations between all study measures are presented. Finally, regression analyses are used to examine the unique and combined contributions of EF, ToM, and verbal ability to the prediction of children’s control of positive and negative affective displays within the disappointment procedure as well as their score on the emotional control scale of the BRIEF-P.

3.1. Descriptives for the disappointment procedure

Inter-rater reliability was calculated using interclass correlations (ICC) for ratings provided by two raters on 20% of the sample for children’s positive behaviors after receiving their first choice toy (ICC = .87, \( p < .001 \)) and last choice toy (ICC = .91, \( p < .001 \)), and for children’s negative behaviors after receiving their first choice toy (ICC = .92, \( p < .001 \)) and last choice toy (ICC = .86, \( p < .001 \)).

Two measures of ER were developed from the disappointment procedure. A positive dimension reflected the degree to which behavior reflected positive affect, and a negative dimension the degree of negative affect. Because some mistaken gift sessions did not continue to the 20 s limit, a proportion score for each behavior was calculated. Behaviors within each dimension were then summed with the result that each child received an averaged proportion score for positive and negative behaviors for both the desirable gift and the undesirable gift presentations. The positive and negative behaviors were moderately correlated for the desirable gift (\( r = −.31, p < .02 \)) and for undesirable gift (\( r = −.40, p < .01 \)), suggesting that positive and negative behaviors operated somewhat independently in this situation. For this reason, each dimension was entered separately in further analyses.

The means, standard deviations and ranges for positive and negative behaviors when receiving a desirable or undesirable gift are presented in Table 1. Overall, the affective content of children’s behavior was congruent with the desirability of the gift. Differences between the means for desirable and undesirable gift were significant for both the positive behaviors, \( t(55) = 2.71, p < .01 \), and negative behaviors, \( t(55) = −4.77, p < .001 \). Consistent with previous
findings, children generally had a higher rate of positive than negative behavioral responses (Cole, 1986).

3.2. Developmental trends

3.2.1. Performance-based measures of executive function

Consistent with previous reports of age trends on EF tasks in preschoolers (Carlson, 2005; Gathercole, Pickering, Ambridge, & Wearing, 2004; Zelazo, Müller, Frye, & Marcovitch, 2003), both the inhibition and working memory measures showed significant age trends (see Table 2). Older preschoolers performed better on both tasks. The effect size for working memory ($f = .66$) was large and the effect size for inhibition ($f = .34$) was medium. There was no significant effect of age for the shifting measure.

3.2.2. Emotional regulation

To obtain a measure of emotion regulation that was adjusted for baseline differences in affective displays, composite scores for positive and negative behaviors were created by subtracting the proportion of positive/negative behaviors after receiving the first choice gift from the proportion of the respective behaviors displayed after receiving the last choice gift. The result was

<table>
<thead>
<tr>
<th>Measure</th>
<th>Younger preschoolers ($n = 30$)</th>
<th>Older preschoolers ($n = 30$)</th>
<th>Age effects</th>
<th>Partial $\eta^2$</th>
<th>$f$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EF measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition</td>
<td>$-.33 (.13)$</td>
<td>$.31 (.74)$</td>
<td>$F(1,58) = 6.84^*$</td>
<td>.11</td>
<td>.34</td>
</tr>
<tr>
<td>Working memory</td>
<td>$-.56 (.41)$</td>
<td>$.54 (1.10)$</td>
<td>$F(1,58) = 25.66^{***}$</td>
<td>.31</td>
<td>.66</td>
</tr>
<tr>
<td>ID/ED shifting</td>
<td>$.11 (1.11)$</td>
<td>$-.11 (.87)$</td>
<td>$F(1,54) = .69$</td>
<td>.01</td>
<td>.11</td>
</tr>
<tr>
<td><strong>ER measures</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Positive dimension</td>
<td>$-.08 (.13)$</td>
<td>$.00 (.09)$</td>
<td>$F(1,55) = 6.54^{**}$</td>
<td>.11</td>
<td>.35</td>
</tr>
<tr>
<td>Negative dimension</td>
<td>$.07 (.11)$</td>
<td>$.05 (.08)$</td>
<td>$F(1,55) = .73$</td>
<td>.01</td>
<td>.03</td>
</tr>
<tr>
<td>BRIEF-P emotional control</td>
<td>$16.30 (4.14)$</td>
<td>$15.64 (3.17)$</td>
<td>$F(1,57) = .46$</td>
<td>.01</td>
<td>.09</td>
</tr>
<tr>
<td>(raw score)</td>
<td></td>
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<tr>
<td>PPVT-III (raw score)</td>
<td>$55.97 (12.80)$</td>
<td>$79.00 (14.21)$</td>
<td>$F(1,59) = 43.54^{***}$</td>
<td>.43</td>
<td>.84</td>
</tr>
<tr>
<td>ToM composite</td>
<td>$-.45 (.82)$</td>
<td>$.45 (.97)$</td>
<td>$F(1,59) = 14.95^{***}$</td>
<td>.21</td>
<td>.49</td>
</tr>
</tbody>
</table>

* $p < .05$, two tailed.
** $p < .01$, two-tailed.
*** $p < .001$, two-tailed.
difference scores for positive and negative behaviors. As seen in Table 2, older children produced considerably more positive behaviors when receiving an undesirable gift than their younger peers, $F(1, 55) = 6.54, p < .02$, but both groups demonstrated a similar amount of negative behavior after receiving the undesirable gift, $F(1, 55) = .73, p > .05$. The effect size for the positive dimension was medium, $f = .35$.

Raw scores from parent ratings on the BRIEF-P emotional control scale did not reveal an age trend $F(1, 57) = .46, p > .50$.

### 3.2.3. Measures of theory of mind

A composite score was computed by summing the standardized scores for the false belief questions. As expected, older preschoolers performed better than their younger counterparts, $F(1, 59) = 14.95, p < .01$. The effect size was medium, $f = .49$ (Table 3).

### 3.3. Relations among measures

#### 3.3.1. Relations among ER variables

Our procedures resulted in three measures of ER: the difference in positive behaviors when receiving a desired gift and undesired gift, the difference in negative behaviors when receiving a desired gift and undesired gift, and the emotional control scale from the BRIEF-P. Scores on the emotional control BRIEF-P scale were not significantly correlated with changes in negative behavior ($r = -.13, n = 55, p > .05$) and changes in positive behavior ($r = .06, n = 55, p > .05$) and these results remained when controlling for verbal ability (see Table 4). Thus, increased problem behaviors related to emotional control, as rated by parents, was not significantly related to displays of either positive or negative behaviors when receiving an undesirable gift.

#### 3.3.2. Relations between ER and EF measures

Children with better inhibitory abilities on the gift delay task demonstrated more positive behaviors when receiving an undesirable gift compared to when they received a desirable gift ($r = .25, n = 56, p = .06$; see Table 4), although the relation was only marginally significant. This relation did not remain significant after controlling for receptive vocabulary. Consistent with previous findings (Kieras et al., 2005), inhibition was not significantly related to the difference in negative behavior composite ($r = -.11, n = 56, p > .30$). All other EF tasks were unrelated to the positive and negative behavior composites.

The emotional control scale from the BRIEF-P was significantly related to the other BRIEF-P scales (see Table 4) and this relation remained significant after controlling for the effects of language. However, parental ratings of emotional control were unrelated to children’s scores on the performance-based EF tasks.

#### 3.3.3. Relations between ER and theory of mind

None of the ER measures (i.e., negative and positive behavior composites as derived from the disappointment procedure, emotional control scale of BRIEF-P) was related to the ToM composite (see Table 4). However, when controlling for verbal ability, the relation between ToM and the emotional control scale of the BRIEF-P approached significance ($r = .26, n = 55, p = .054$).

#### 3.3.4. Relations between ER and PPVT

Verbal ability was related only to the difference in positive behavior composite ($r = .36, n = 57, p < .01$; see Table 4). Children with better vocabulary skills had higher difference scores for positive
Table 3
Simple (and partial) correlations between EF, ER, and social cognition measures

<table>
<thead>
<tr>
<th>EF measures</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>
</tr>
</thead>
<tbody>
<tr>
<td>1 Inhibition composite</td>
<td>–</td>
<td>.37** (.18)</td>
<td>−.06 (−.02)</td>
<td>.25† (.13)</td>
<td>−.11 (−.17)</td>
<td>−.17 (−.11)</td>
<td>−.05 (.03)</td>
<td>−.22 (−.22)</td>
<td>−.11 (−.04)</td>
<td>.28† (.18)</td>
<td>.36**</td>
</tr>
<tr>
<td>2 WM (Backward Digit)</td>
<td>–</td>
<td>−.23 (−.21)</td>
<td>.19 (−.08)</td>
<td>.06 (−.04)</td>
<td>−.07 (−.06)</td>
<td>−.11 (.03)</td>
<td>.02 (.07)</td>
<td>−.08 (.08)</td>
<td>.45** (.33†)</td>
<td>.68**</td>
<td></td>
</tr>
<tr>
<td>3 Extradimensional shift</td>
<td>–</td>
<td>−.08 (−.04)</td>
<td>.00 (−.01)</td>
<td>−.05 (−.07)</td>
<td>.08 (.06)</td>
<td>.04 (.04)</td>
<td>.08 (.06)</td>
<td>−.01 (.03)</td>
<td>−.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Difference in positive affect</td>
<td>–</td>
<td>−.40* (−.48**)</td>
<td>.02 (.09)</td>
<td>.14 (.23)</td>
<td>.13 (.15)</td>
<td>.06 (.15)</td>
<td>.22 (.11)</td>
<td>.36**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Difference in negative affect</td>
<td>–</td>
<td>−.20 (−.19)</td>
<td>−.16 (−.14)</td>
<td>−.01 (−.01)</td>
<td>−.13 (−.11)</td>
<td>−.01 (−.06)</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 BRIEF-P inhibit</td>
<td>–</td>
<td>.64** (.62**)</td>
<td>.21 (.21†)</td>
<td>.28 (−.26)</td>
<td>.06 (.13)</td>
<td>−.17</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7 BRIEF-P WM</td>
<td>–</td>
<td>.32* (.31†)</td>
<td>.43** (.41†)</td>
<td>−.08 (−.02)</td>
<td>−.20</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8 BRIEF-P shift</td>
<td>–</td>
<td>.52** (.52†)</td>
<td>.00 (.01)</td>
<td>−.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 BRIEF-P emotional control</td>
<td>–</td>
<td>.17 (.26†)</td>
<td>−.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 ToM composite</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>11 PPVT</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note. Partial correlations control for PPVT-3.
* p < .05, two-tailed.
** p < .01, two-tailed.
† p < .06.
Table 4
Simple (and partial) correlations between emotion regulation measures and all other measures

<table>
<thead>
<tr>
<th>Measures of emotion regulation</th>
<th>Difference in positive behaviors</th>
<th>Difference in negative behaviors</th>
<th>BRIEF-P emotional control scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EF measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition composite</td>
<td>.25† (.13)</td>
<td>−.11 (−.17)</td>
<td>−.11 (−.04)</td>
</tr>
<tr>
<td>WM (Backward Digit Span)</td>
<td>.19 (−.08)</td>
<td>.05 (−.04)</td>
<td>−.08 (.08)</td>
</tr>
<tr>
<td>Shifting (extradimensional shift)</td>
<td>−.08 (−.04)</td>
<td>.00 (.01)</td>
<td>.08 (.06)</td>
</tr>
<tr>
<td><strong>BRIEF-P</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibit scale</td>
<td>.02 (.09)</td>
<td>−.20 (−.19)</td>
<td>.28* (.26†)</td>
</tr>
<tr>
<td>WM scale</td>
<td>.14 (.23)</td>
<td>−.16 (−.14)</td>
<td>.43** (41**)</td>
</tr>
<tr>
<td>Shift scale</td>
<td>.12 (.15)</td>
<td>−.01 (−.01)</td>
<td>.52** (.52**)</td>
</tr>
<tr>
<td>EC scale</td>
<td>.06 (.15)</td>
<td>−.13 (−.11)</td>
<td></td>
</tr>
<tr>
<td>ToM composite</td>
<td>.22 (.11)</td>
<td>−.02 (−.06)</td>
<td>.17 (.26†)</td>
</tr>
<tr>
<td>PPVT</td>
<td>.36**</td>
<td>.12</td>
<td>−.21</td>
</tr>
</tbody>
</table>

Note. Partial correlations control for PPVT-3.
* p < .05.
** p < .01.
† p < .06.

3.3.5 Prediction of ER

Next, we addressed the question of whether the EF measures would predict individual differences in ER after controlling for verbal ability. We conducted separate hierarchical regression analyses for two of the three ER measures: the positive behavior composite and the emotional control scale of the BRIEF-P. For the positive behavior composite from the disappointment procedure, we used the score from the undesirable gift segment as the criterion and then entered the score from the desirable gift segment as the first predictor. This procedure results in difference scores that are more statistically reliable than simple difference scores (Dugard & Todman, 1995).

3.3.5.1 Positive behavior composite. In order to determine the specific contributions of the inhibition measure to the positive behavior composite with the other EF measures and PPVT accounted for, we conducted two hierarchical regression analyses. The positive behavior composite from the desirable gift segment was entered in the first block, PPVT was entered in the second block. PPVT was found to be a significant predictor, \( \beta = .26, t(53) = 2.01, p = .05 \). The inhibition score was entered in the third block, and consistent with the partial correlations reported, inhibition was not a significant predictor, \( \beta = .19, t(53) = 1.37, p = .18 \). The WM and shifting scores were entered simultaneously in the fourth block, and did not account for significant variation in change in positive behaviors over and above the inhibition measure and controls. The results of the final model are shown in Table 5.

For the second hierarchical regression analysis, the order of entry was reversed for the third and fourth blocks, with the WM and shifting scores entered in the third block (i.e., after PPVT) and inhibition was entered in the last block. Neither WM nor shifting was significant related to changes in positive behaviors (\( \beta s = .10 \text{ and } .13, \text{ps} = .45 \text{ and } .46 \)). Therefore, there is no evidence
Table 5
Summary of hierarchical regression analysis for variables predicting changes in positive behaviors (final model)

<table>
<thead>
<tr>
<th>Variable</th>
<th>End βa</th>
<th>t</th>
<th>R²</th>
<th>ΔR²</th>
<th>d.f.</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st choice gift</td>
<td>.30</td>
<td>2.15*</td>
<td>.08</td>
<td>.08</td>
<td>1, 52</td>
<td>4.54*</td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT</td>
<td>.14</td>
<td>.78</td>
<td>.15</td>
<td>.07</td>
<td>1, 51</td>
<td>4.03*</td>
</tr>
<tr>
<td>Block 3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition</td>
<td>.17</td>
<td>1.21</td>
<td>.18</td>
<td>.03</td>
<td>1, 50</td>
<td>1.87</td>
</tr>
<tr>
<td>Block 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working memory</td>
<td>.07</td>
<td>.49</td>
<td>.19</td>
<td>.01</td>
<td>2, 48</td>
<td>.23</td>
</tr>
<tr>
<td>Shifting</td>
<td>.11</td>
<td>.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 54.

a β values are standardized
* p < .05.

Table 6
Summary of multiple regression analysis for variables predicting emotional control scale of BRIEF-P (final model)

<table>
<thead>
<tr>
<th>Variable</th>
<th>End βa</th>
<th>t</th>
<th>R²</th>
<th>ΔR²</th>
<th>d.f.</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPVT</td>
<td>−.13</td>
<td>−1.19</td>
<td>.37</td>
<td>.37</td>
<td>4, 53</td>
<td>7.67**</td>
</tr>
<tr>
<td>BRIEF-P inhibit scale</td>
<td>−.003</td>
<td>−.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIEF-P WM scale</td>
<td>.28</td>
<td>1.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIEF-P shift scale</td>
<td>.43</td>
<td>3.70**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 58.

a β values are standardized.
** p < .01.

of WM and shifting scores predicting change in positive behaviors, even without controlling for inhibition.

3.3.5.2. Emotional control from BRIEF-P. As all other scales on the BRIEF-P were significantly correlated with the emotional control scale, we conducted a multiple regression analysis to determine which of these other scales explained a unique amount of variance in the BRIEF-P emotional control scale. Parent ratings on the emotional control scale of the BRIEF-P was entered as the criterion and the PPVT score along with the other BRIEF-P scales (i.e., inhibit, WM, and shift) were entered as predictors. These results are shown in Table 6. While the model was significant, $R^2 = .37, F(4, 57) = 7.67, p < .001$, only the shifting scores significantly predicted emotional control scores, $β = .43, t(53) = 3.70, p < .01$.

4. Discussion

The primary goal of the present study was to elucidate the relation between ER and social–cognitive development using multiple measures of ER, EF, and ToM. Preschool children were administered a battery of EF tasks along with the disappointment procedure (i.e., a performance-based measure of ER), two ToM tasks, and a measure of verbal ability. In addition, a parent completed a behavior rating scale of EF (BRIEF-P) that assessed EF in the context of
children’s everyday behaviors. Whereas there were no relations between ER and ToM, the relation between ER and a specific performance-based component of EF (i.e., inhibition) approached significance. However, our findings indicated that children’s performance on the inhibition measure was not a significant predictor of ER over and above the effects of verbal ability and other components of EF. A different pattern emerged for the parent ratings of EF and ER. Here, shifting explained a unique amount of variance in ER (as measured by the BRIEF-P).

4.1. Developmental trends for disappointment procedure, EF tasks, and ToM

Age-related changes in ER have previously been reported in the literature when traditional measures of emotional control, such as facial expression or physiological markers, were used (e.g., Fox & Calkins, 2003). However, previous research provides contradictory results regarding age-related changes in performance on the disappointment procedure. In Saarni’s (1984) original study, age differences in both positive and negative behaviors were found. In contrast, Kieras et al. (2005) failed to find age differences in 3–5-year-olds’ displays of positive or negative affect. The results of the present study partially replicate Saarni’s findings as older children tended to display more positive behaviors in a disappointing situation than younger children. There were, however, no age differences in the display of negative behaviors in the present study. Our findings suggest that it may be easier to control socially expected positive reactions toward a well-learned situation (i.e., receiving a gift) than controlling the display of negative emotions in this situation (i.e., masking socially disapproved negative behaviors). These results support the notion that masking disappointment is a form of ER that develops during the preschool period (Saarni, 1984).

Significant developmental trends were found for children’s performance on all EF tasks, with the exception of the measure of shifting. These findings replicate previous research which has shown that different components of EF have different developmental trajectories (e.g., Carlson, 2005; Diamond & Taylor, 1996; Hughes, 1998; Luciana & Nelson, 1998; Welsh, Pennington, & Groisser, 1991). In keeping with previous research using the ID/ED shift paradigm (Wall, 2003), findings from the present study suggest that shifting abilities, as measured by the four phases in the ID/ED shift, do not show the same developmental progression as other EF tasks in 3–5-year-old children.

Children’s performance on the ToM tasks demonstrated age-related changes in line with those extensively reported in the literature (e.g., Carlson et al., 2004). Thus, the developmental trends in children performance in the present sample are consistent with those previously reported in other samples of typically developing children.

4.2. Relation between ER and EF

In keeping with Kieras et al. (2005), we found that children who performed poorly on tasks measuring inhibition tended to show decreased positive affect after receiving an undesirable gift as compared to the amount of positive affect they display after receiving a desirable gift. In contrast, the regulation of negative behaviors was not related to any performance-based measures of EF.

The relation between inhibition and the ability to display positive behavior in a disappointing situation may result from the role inhibitory control plays in preventing a prepotent negative response and facilitating the substitution of a more socially acceptable response. Indeed, the ability to inhibit a negative response to the disappointment inherent in receiving an undesirable gift may offer a redeeming quality. Several children in the present study quickly compensated for their
initial disappointment by approaching the situation from a different, more positive perspective. One child commented that the gift was “perfect,” despite having previously ranked it as her least liked toy, because, as she reasoned, she could give it to a baby cousin who would enjoy playing with it. This example demonstrates the potential influence of inhibitory abilities in a disappointing situation and underscore how EF and ER represent multi-componential constructs with complex relations between them.

However, the correlation between inhibition and ER was small. Furthermore, inhibition did not predict the regulation of positive behaviors after controlling for verbal ability. The difference between our findings and those by Kieras et al. could be due to the fact that Kieras et al. assessed response inhibition, whereas we assessed delay inhibition. Clearly, the relation between different aspects of inhibition and ER needs further study. In addition, in assessing the relation between inhibitory control and ER, Kieras et al. (2005) did not control for verbal ability.

The finding that verbal ability is significantly related to ER supports the suggestion by Kopp (1989, p. 349) that “language offers young children a multipurpose vehicle for dealing with emotions and moving toward more effective ER. With language, children can state their feelings to others, obtain verbal feedback about the appropriateness of their emotions, and hear and think about ways to manage them.” Future studies should focus on the role that language plays in mediating the relation between inhibition and ER, using multiple measures of inhibition and ER.

The significant relations between the BRIEF-P measure of ER (i.e., Emotion Control scale) and the other scales of the BRIEF-P are consistent with those found by the authors of the questionnaire (Gioia et al., 2003). The regression analysis involving the Emotion Control scale of the BRIEF-P revealed that the shift scale of the BRIEF-P explained a unique amount of variance in children’s ability to control their emotions in everyday situations. Examination of the composition and theoretical rationale for each scale provided by the authors of the BRIEF-P suggests some possible reasons for this relation. The shift scale, according to Gioia et al. (2003), may be particularly sensitive to dealing with disappointment or a change in plans. Given that children who struggle with moving on from a disappointment often express this difficulty through emotional behavior, the relation between the shift and emotional control scales is not surprising. In addition, situations where children have difficulty shifting or sticking to a task are often situations where children are expected or pressured to conform to the social expectation, and these situation may be infused with emotion. In other words, the relations between parents’ evaluations of emotional control and shifting, may speak to the way that emotions infuse, constrain, and direct behaviors in young children.

The correlations between performance-based measures of ER and EF and parental ratings of those constructs were generally low and not significant. Although we found a correlation approaching significance between the children’s performance on the disappointment procedure and a performance-based EF task, we did not find significant correlations between the children’s performance on the EF tasks and parental ratings of their children’s EF and ER in everyday situations (see also Bodnar et al., 2007). These findings suggest that multi-method measures of ER and EF may be tapping into different aspects of these constructs. More specifically, the sampling of everyday behaviors related to ER and EF via the BRIEF-P may correspond to more general processes of EF as parents may rely upon general impressions of behavior in answering specific questions. The performance-based measures constrain and segment behaviors as researchers rely upon specific behaviors to infer specific processes of EF. These differences may account for the lack of within-construct correlation between the performance-based and parental measures. If the BRIEF-P does assess a more general construct of EF, it should only be used to determine a general level of EF in children and not to identify deficits in any specific aspect of EF.
4.3. Relation between ER and theory of mind

In the present study, no significant relations were found between ToM and the disappointment procedure. This suggests that even though children’s regulation of emotions in the disappointed procedure is likely influenced by their understanding of social display rules that pertain to behaviors displayed when receiving a gift, the extent to which they were successful in producing positive responses to an undesirable gift did not relate to their ability to reflect on their own and others’ mental states. This is in contrast to findings reported by Garner and Power (1996) with regard to social cognitive knowledge about other people’s feelings. In their study, children’s knowledge about the emotions of others did make a significant contribution to the prediction of children’s positive behavior in the disappointment situation.

Josephs (1994) has argued that the use of a display rule, such as “smile when you receive a gift,” does not require a systematic understanding of the difference between the appearance of positive expressive behavior and the reality of negative (hidden) feeling. Thus, ToM may not play a central role in emotional dissemblance, despite the strong social nature of the disappointment situation. It may be that children simply substitute one personal script (i.e., reject the things you don’t like) for another social script (i.e., graciously accept gifts) without actually understanding the reasons why dissembling an emotional response may be valuable. In addition, using ToM knowledge within the disappointment procedure may place additional requirements on the child that are not present in the standard false belief task. Children must infer and compare two possible emotional outcomes in the disappointment procedure whereas the standard false belief task requires comparing an actual state with one inferred state. The ability to coordinate two inferred states is a more complex task than false belief understanding and may therefore be unrelated to it. Alternatively, some children may use dissembled responses in these situations not to follow a social rule but to maintain the relation with the gift giver, especially if the gift giver is not a parent or highly familiar figure to the child (Cole, 1986).

An objective for future studies would be to find measures of ER for which no social script can be specified (i.e., measures that require the child to utilize internal emotional control processes). We believe that these kinds of measures will help to clarify the relation between ER and ToM. Our data are suggestive of a relation between social understanding and ER as indicated by the significant relation between the emotional control scale of the BRIEF-P and ToM after controlling for verbal ability.

5. Conclusions

The analysis of the relation between ER, EF, and ToM with multiple measures presents an important initial step in understanding the development of ER and how it relates to social–cognitive processes. Although we found no direct association between measures of ToM and ER, we found evidence for unique relations between specific components of both ER and executive processes. What remains to be elucidated is the nature of these differential associations involving the multiple components of ER and EF and how they influence children’s behaviors. Diverse measures of ER may help explain the nature of the relation between EF and ER in terms of the direction of influence, i.e., is EF a prerequisite for ER, is ER a prerequisite for EF, or are they both part of a single coordinated system? Further, the use of such measures in longitudinal studies, as opposed to cross-sectional studies, would serve to clarify the developmental relations between ER, EF, and ToM in typical development.
Appendix A. Behaviors coded in the disappointment procedure

Positive dimension:
1. Smile—lip corners pulled up.
2. Positive vocalization about gift, e.g., using light, lilting tone and using words reflecting something positive about the gift.
3. Smiling eye contact with experimenter.
4. Identifies with gift—e.g., hugs gift, plays with toy, claims ownership (i.e., “now I have two orange cars.”)
5. Verbalization of usefulness to others.

Negative dimension:
1. Straight-line or pursed mouth.
2. Negative verbalization about the gift, e.g., whiny or insistent tone and using words reflecting something negative about the gift.
3. Shoulder shrug.
4. Distances from gift—e.g., pushes toy away, says “don’t want it,” examines toy but does not play with it.

References


