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Developmental changes in anger expression and attention focus: Learning to wait

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Abstract

Being able to wait is an essential part of self-regulation. The present study examined the developmental course of changes in the latency to and duration of target waiting behaviors by

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Data were analyzed with a random-intercept model of the form:

$$\begin{gathered}
L_1{:}Yij=\beta_{oij}+\beta_1 time_{ij}+\beta_2 time_{ij}*time_{ij}+\beta_3 DistractionDuration_{ij}+\\
\beta_4 DistractionLatency_{ij}+\beta_5 BidDuration_{ij}+\beta_6 BidLatency_{ij}+e_{ij}\\
L_2{:}\beta_{oij}=\gamma_{00}+\gamma_{01}\ DistractionDurationPersonMean_{\,j}+\gamma_{02}\\
DistractionLatencyPersonMean_{\,j}+\gamma_{03}\ BidDurationPersonMean_{\,j}+\gamma_{04}\\
BidLatencyPersonMean_{\,j}\\
\beta_{1ij}=\gamma_{01}.
\end{gathered}$$

The intercept term β_{oij} was composed of the fixed term, β_o, and random variation due to subjects, μ_{0j}, and observations over time ε_{0ij}; thus, $\beta_{oij} = \beta_o + \mu_{0j} + \varepsilon_{0ij}$. The subscript *j* indexes subjects, and *i* indexes observations within subjects. Terms with subscript *ij* are at Level 1 of the growth curve model, whereas those with subscript *i* are at Level 2. Nonsignificant main effects are removed (e.g., $\beta_2 time_{ij} * time_{ij}$) before testing interactions between *timeij* and Level 1 behavior predictors (e.g., $\beta_9 Time_{ij} X DistractionDuration_{ij}$).

following 65 boys and 55 girls from rural and semi-rural economically strained homes from ages 18 to 48 months. Age-related changes in latency to and duration of children's anger expressions and attention focus (e.g., self-initiated distraction) during an eight minute wait for a gift were found. On average, at 18 and 24 months of age, children were quick to react angrily and slower to shift attention away from the desired object than they were at later ages. Over time, children were quicker to distract themselves. By 36 months, distractions occurred before children expressed anger, and anger expressions were briefer. At 48 months, children typically made a quick bid to mother about demands of waiting before distracting themselves; on average, they did not appear angry until the latter half of the wait. Unexpectedly, children bid to their mothers as much at age 48 months as they had at 18 months; however bids became less angry as children got older. Developmental changes in distraction and bidding predicted age-related changes in the latency to anger. Findings are discussed in terms of the neurocognitive control of attention around age 30 months, the limitations of children's self-regulatory efforts at age 48 months, and the importance of fostering children's ability to forestall, as well as modulate, anger.

Keywords

Emotion regulation; self regulation; toddlers; preschoolers

The ability to wait, an important aspect of self-regulation that contributes to children's socio-emotional competence, school readiness, and mental health, develops during the transition from toddlerhood to preschool age (Calkins, 2007; Kopp, 1982). By kindergarten age, teachers expect children to have sufficient self-regulatory skill to postpone their goals (e.g., to play with a desired object) and to focus their attention on teacher-defined activities even if they conflict with children's personal goals (Blair, 2002; Denham, 2006; Graziano, Reaves, Keane, & Calkins, 2007; Rimm-Kaufman & Pianta, 2000; United States Department of Education, 1993). Preschool and elementary school age children with behavior problems have difficulty with this skill; they are more angry, non-compliant, and dysregulated than typically developing children are during a wait (Cole, Teti, & Zahn-Waxler, 2003; Supplee, Skuban, Shaw, & Prout, 2009). Moreover, preschool age skill at waiting predicts several aspects of adolescent functioning (Eigsti, Zayas, Mischel, Shoda, Ayduk, Dadlani et al., 2006; Shoda, Mischel, & Peake, 1990). Each of these facts supports a key feature of prevention programs for at risk preschoolers—skill at coping with frustration (e.g., Domitrovich, Cortes, & Greenberg, 2007; Izard, King, Trentacosta, Morgan, Laurenceau et al., 2008).

Being able to wait for a desired object or activity is a component of self-regulation, defined as the modulation of behavior according to the social demands of a situation (Posner & Rothbart, 2000). Self-regulation is conceptualized as entailing the integrated control of emotion, attention, and action (Bell & Deater-Deckard, 2007; Blair, 2002; Calkins & Bell, 2010). In studies of emerging self-regulation in early childhood, children are often instructed to wait for a desirable toy or gift. The child's waiting behavior is typically measured in terms of a) how quickly or how often the child tries to get the restricted object; Kochanska, Coy, & Murray, 2001; Vaughn, Kopp, & Krakow, 1984) or b) or how much or how intensely the child expresses anger during the wait (Cole et al., 2003; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002). These measures are assumed to reflect aspects of self-regulation and to relate to one another, but their relation and how it develops in early childhood have not been fully detailed.

Yet, the ability to wait is thought to depend in part on skill at anger regulation (Calkins & Johnson, 1998; Crockenberg & Litman, 1990; Kopp, 1989; Stifter, Spinrad, & Braungart-Reiker, 1999). Specifically, the ability to distract oneself (i.e. to shift attention from a desired goal and focus it on an alternate activity) is correlated with both better compliance and less anger (e.g., Calkins & Johnson, 1998; Kochanska, Coy, & Murray, 2001; Peake, Hebl, & Mischel, 2002). The self-initiation of shifting attention away from a desired but restricted object involves effortful control of attention, which is viewed as central to self-regulation (Posner & Rothbart, 2000; Calkins, 2007). If self-regulation is best understood as the integrated control of emotion, attention, and action (Bell & Deater-Deckard, 2007; Blair, 2002; Calkins & Bell, 2010), it is essential to detail how developmental changes in one domain—attention control—relate to changes in another domain—anger.

The study of a developmental link between anger and attention control requires longitudinal analysis. Prospective longitudinal studies evaluating change from preschool to school age (Eisenberg, Fabes, Nyman, Bernzweig, & Pinuelas, 1994; Eisenberg, Sadovsky, Spinrad, Fabes, Losoya et al., 2006) and from infancy to toddlerhood (Braungart-Rieker & Stifter, 1995; Rothbart, Ziaie, & O'Boyle, 1991) point to the likelihood of such a link. However, only one study (Eisenberg, Spinrad, Eggum, Silva, Reiser et al., 2010) examined relations among emotion, attention, and action during the transition from toddler to preschool age, when self-initiated effortful regulation should appear (Kopp, 1982 Kopp, 1986). Predictive relations were not found, but attention control was assessed as a dimension of temperament (effortful control) reported by mothers and not observed directly. Effortful control includes but is not limited to attention control. Other work has shown that toddler effortful control predicted kindergarten age ability to use distraction to comply with instructions to wait (Kochanska et al., 2001; Eisenberg et al., 2009). It is also known that anger frequency and intensity decrease, and regulatory strategy use (including use of distraction) increases, between infancy and toddlerhood (Grolnick, Bridges, & O'Connell, 1996; Mangelsdorf, Shapiro, & Marzolf, 1995; Vaughn et al., 1984). The present study added to this literature by directly examining longitudinal relations between changes in observed anger and observed attention focus during the age period in which children begin to self-initiate regulatory strategies that promote compliance and manage frustration.

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Because anger serves adaptation by equipping people to overcome barriers to goals (Barrett & Campos, 1987), the aim of socialization is not to eliminate children's anger but to help them harness it, i.e. to regulate anger in order to deal with blocked goals in appropriate ways. Self-regulation includes both a) socially appropriate persistence at overcoming a barrier, and b) tolerating limits by inhibiting efforts to overcome barriers when appropriate (Posner & Rothbart, 2000). When a parent or teacher has told a child to wait for a desired object until the adult has finished a task, it is usually not appropriate for the child to persist in trying to get the object. Four- and five-year-olds are frustrated by this type of wait (e.g., Cole et al., 2003; Gilliom et al., 2002) despite the normative decline in anger reactivity between toddlerhood and preschool age (Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999; Hill, Degnan, Calkins, & Keane, 2006; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007). The decline in anger reactivity, however, is generally assessed in terms of anger intensity or total time spent angry. Because preschoolers often become angry during a long boring wait for something they want despite skill they are gaining at self-regulation, changes in the temporal aspects of their anger may expressions may be sensitive indices of their regulation (Thompson, 1994). Therefore, examination not of the occurrence of anger and regulatory behaviors but of their time-related features may capture important developmental changes. Over this period of development, children should be slower to anger (longer latency) and quicker to recover from it (shorter duration), and these changes should be associated with quicker initiation of an appropriate regulatory strategy (shorter latency to distraction) and sustaining it longer (longer duration of distraction). Variables such as latency and duration are rarely examined (but see Calkins & Johnson, 1998), although latency to and recovery from emotions may be sensitive indices of regulation (Davidson, 1998; Thompson, 1994).

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Examination of age-related changes in latency to and recovery from anger has potential to strengthen inferences that anger is being regulated without relying wholly on observing anger (Cole, Martin, & Dennis, 2004). Observations of contingent sequences of emotion-strategy-emotion reveal that infant and toddler age strategic efforts reduce emotion intensity momentarily but are of limited effectiveness (Buss & Goldsmith, 1998; Stifter & Braungart, 1995). If young children's regulatory efforts improve as expected between the toddler and preschool years, then the duration of anger displays should decrease, and shorter anger duration should be associated with increases in the duration of distraction (sustaining attention focus away from a desired object). Self-regulation, however, may also entail regulatory behavior *prior* to expressing anger, as is the case for adults (Gross, 1998). When a 4-year-old emits a deep sigh after minutes of waiting and says to his mother, "Aren't you done *yet*?" it seems the child was effortfully forestalling frustration despite no observed anger. Therefore, it is also reasonable to expect that anger latency should increase between toddler and preschool ages and that the increase should be associated with quicker latency to self-initiate behaviors known to regulate emotion (i.e. distraction). In sum, understanding developmental changes in latency and duration of behaviors (anger expression, attention focus) and their relations will enrich our understanding of the development of self-regulation.

The strategic deployment of attention, including the ability to engage in focused distraction, emerges in the third year of life (Kochanska et al., 2001; Ruff & Capozzoli, 2003). Around this time, children begin to initiate distractions more often (Mangelsdorf et al., 1995; Supplee et al., in press), probably due to the development of an executive attention system that supports effortful attention control (Beauregard, Levesque, & Pasquette, 2004; Blair & Diamond, 2008; Jones, Rothbart, & Posner, 2003). We therefore predicted that longer and quicker distractions would be observed by age 36 months and that changes in how a child engages in distraction would be associated with increases in anger latency by 36 months of age. However, recognizing the importance of experience and the continuing maturation of neural systems for effortful control (Gogtay, Giedd, Lusk, Hayashi, Greenstein, Vaituzis, et al., 2004), we included assessment at age 48 months to examine whether the relation between attention and anger becomes stronger even after it is first established.

In contrast to distracting oneself, focusing attention on a desired but restricted object could elicit and even maintain young children's anger (Buss & Goldsmith, 1998; Peake et al., 2003). Therefore, bidding to an adult about the demands of waiting, which young children commonly do (Grolnick, Kurowksi, McMenamy, Rivkin, & Bridges, 1998; Rothbart, Ziaie, & O'Boyle, 1992; Stansbury & Sigman, 2000), should not be associated with improvements in anger latency and recovery (e.g., duration), particularly if the bid does not result in resolving the problem. Bids to an adult keep a child's attention on the blocked goal and should be associated with quicker, longer bouts of anger. We investigated whether developmental changes in the latency and duration of children's bids to their mothers about the demands of waiting were related to changes in anger latency and duration.

In sum, the present study tested the prediction that between ages 24 and 36 months, children would be slower to display anger and quicker to distract and their anger would be briefer and their self-initiated distractions longer. Furthermore, we expected that relations between the latency and duration of self-initiated distraction and of anger expressions would emerge by 36 months of age. Because most three- and four-year-olds are frustrated by waiting, we expected children to show interest in the restricted object at all ages. This interest would take the form of touching and trying to open the gift as well as bidding to mother about the long wait, the desire to open the gift, and the inadequacy of a single, boring toy. Moreover, we did not expect these bids to predict age-related improvement in anger expression because

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they retained the child's attention on the blocked goal. Finally, we expected stronger relations between attention focus and anger by age 48 months.

Programs promoting preschoolers' emotional competence are typically aimed at low income urban children (e.g., Domitrovich et al., 2007; Izard et al., 2008), but rural children are also exposed to economic conditions that may compromise their socioemotional development (Cooper, Valleley, Polaha, Begeny, & Evans, 2006; Moore, Mink, Probst, Tompkins, Johnson, & Hughley, 2005). To broaden the demographic base of normative information about self-regulation, we recruited children from rural and semi-rural economically strained homes, in which household income did not qualify the family as poor but was nonetheless below average. Evidence suggests that lower income does not predict poorer anger regulation if caregiving is adequate (e.g., Garner & Spears, 2000; Raver, 2004; Supplee et al., 2009). Therefore, as our sample was not selected in terms of caregiver risk, we expected the data to depict a normative developmental progression.

Method

Participants

A multi stage strategy was used to recruit rural and semi-rural (towns that are developed but surrounded by farm land) families whose incomes were below the national median income but above the national poverty threshold. Using U.S. census data, we identified tracts with high density of families with young children in the target income range. To fully appreciate the communities in which we recruited, we studied the history and current issues of the communities, visited community leaders (e.g., clergy, educators), distributed flyers, and sent letters to eligible families identified through community birth announcements.

As a result, 124 families were enrolled at Time 1, when the child was 18 months of age. At 48 months, 120 families remained enrolled, a retention rate of 96.8% that we attribute to our efforts (annual feedback, graduated compensation amounting to $450 for all visits, newsletters) and to the values of participating families. Withdrawn families did not differ from continuing families on any demographic characteristic, which were assessed annually at child age 18, 30, and 42 months. The 65 boys and 55 girls, seen within two weeks of their half or full birthday, had M ages at each time point of 18.44 (SD = .57), 24.39 (SD = 1.3), 36.44 (SD = .80) and 48.33 (SD = .67) months. Most (93.3%) children were identified as White by their mothers; 6.7% were biracial. Most mothers completed high school (19.2%) or attended (21.7%) or completed college (36.7%). Fathers either completed high school (30.8%) or attended (23.3%) or completed college (26.7%). Mean family size ranged from 3.9 people (1.8 children, SD = .85) at Time 1 to 4.22 (2.2 children, SD = .94) when the target child was age 42 months. Income to needs ratio (i.e. total household income divided by the year's poverty threshold for that family size) averaged 2.3 (SD = .87) at Time 1 and 2.58 (SD = 1.15) at child age 42 months, indicating income above poverty (INR=1) but below middle class (INR=3).

Procedures

Observations were conducted at four home visits (at child age 18, 30, 36, and 42 months) and four lab visits (18, 24, 36, and 48 months). Questionnaires assessed several family and child characteristics annually. Each lab visit was of equivalent length and format, but some tasks varied according to child age; each visit involved a series of standard laboratory anger-eliciting tasks, each separated by a relief activity. In this study, we focused on a wait task (Vaughn et al., 1984), administered at all four age points, in which a child's goal to open a gift was blocked. Mothers were instructed in advance that we wished to see how children develop the ability to wait and that they should a) complete a set of questionnaires they were

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given and b) do what they would ordinarily do when their child needed to wait. Mothers had instructions with them at all times. Only procedure materials and wall posters were in the room.

In the wait task, the RA gave the mother the questionnaires and the child a boring toy: a rubber “lilypad” (18 months), a cloth cymbal (24 months), a toy car with missing wheels (36 months), and a toy horse with missing legs (48 months). The RA also placed a shiny gift-wrapped bag, tied tightly with a ribbon so a young child could not open it, on the child’s table, saying, “This is a surprise for you.” As the RA left, the mother told the child to wait until her work was finished to open the gift. After eight minutes, the RA returned and the mother let the child open the gift.

Coding systems

Two coding systems were implemented by two independent teams. The first identified child anger expressions and the second classified child attention focus. Each team was trained to 80% accuracy with master coders; reliability was estimated on 15% of cases for each system.

Anger expressions—Child anger expressions were coded in 15 second epochs with a coding system that uses facial activity (e.g., furrowed brow, square mouth) and vocal quality (e.g., plosive, harsh quality) to infer anger (Cole, Zahn-Waxler, & Smith, 1994). Across ages, the average κ for anger expressions was .89 (range .81–.93). The 15s epoch unit was used in order to parallel independently coded attention focus (see below). If a facial or vocal component met the criteria for anger, the 15s epoch received a score of 1. If the anger expression continued into subsequent epochs, the anger expression was defined by the set of contiguous 15s epochs in which anger was observed. It was possible that within one 15s epoch, two anger instances could occur (e.g., a child furrows brow and presses lips for 4s, appears neutral for 5s, and then speaks in an angry voice to the mother for 6s). From the 15s epoch data, we created two temporal variables: latency to the first anger expression (number of consecutive 15s epochs prior to the first anger expression) and average anger duration (total number of consecutive 15s epochs in which anger was observed divided by the total number of anger expressions).

Attention focus—Fifteen second epochs provided coders with sufficient time to discern if a child’s attention shift became absorbed in another activity or was fleeting. Only self-initiated behavior was included in the study and only attention shifts in which the child became absorbed in an alternate activity counted as distraction (see Ruff & Capozzoli, 2003). Using the same 15s epochs as the emotion coders, attention focus coders classified the child’s attention as focused on: 1) the gift (looking at, touching, or trying to open the gift), 2) bidding about the demands of the wait (e.g., indicating to mother to open the gift, interrupting mother’s work, or making comments such as “Aren’t you done yet?), and (3) an alternate activity in which the child was absorbed, e.g., playing with the boring toy, looking at posters (i.e. distraction). Bids to mother about other topics (e.g., talking about a poster) were coded separately, were infrequent, and were excluded from this study. As with anger, if a behavior met the criteria for one form of attention focus, the 15s epoch received a score of 1. If that behavior continued into subsequent epochs, the attention focus was defined by the set of contiguous 15s epochs in which that form of attention focus was observed. It was possible that more than one type of attention focus could occur in one 15s epoch. In the latter case, the epoch received a score of 1 for each attention focus (e.g., attention to gift, bid to mother). The M kappa across ages was κ = .82 (range .73 –.91). Latency and average duration variables were generated for each attention focus code in the same fashion as done for anger expressions.

Results

Overview of Analyses and Descriptive Statistics

The untransformed means and standard deviations for the number of epochs until a behavior occurred (latency) and the average number of contiguous epochs in which the behavior occurred (duration) of anger expression, distraction, focus on gift, and bids about the problem of waiting are shown in Table 1 and 2. To improve distributions, however, log transformations were performed on all variables.

The results section is organized around the following study questions:

1. At what ages do children appear angry less quickly and for shorter periods,
2. At what ages do children quickly, and for longer periods, focus attention away from the desired but restricted object (i.e. initiate distraction) and more slowly return their attention the object (focus on the gift, bid to mother about the challenge of waiting), and
3. Do age-related decreases in latency to distraction, and increased duration of distractions, predict slower latency to and duration of anger expressions, whereas latency to and duration of bids about the challenge of waiting do not?

Two sets of analyses addressed these questions. First, developmental changes in the latency to and average duration of anger expressions and different types of attention focus were examined by multivariate repeated measures analysis of variance (GLM; SPSS version 18.0), with planned adjacent age comparisons. This tested predictions that a) between ages 24 and 36 months children expressed anger less quickly and recovered more quickly, b) distracted themselves more quickly and for longer periods, c) bid less quickly and for briefer periods, and d) returned attention to the gift less quickly and for shorter periods. To correct for Type I error given the number of paired age comparisons (n = 12), the significance level was set at $p < .01$. Second, to test the prediction that age-related changes in distraction predict changes in anger latency and duration, and that bids did not, we conducted growth curve modeling (PROC MIXED; SAS version 9.2). The correlation matrix for each target variable at each age is presented in Table 3.

Age-related changes in anger expression and attention focus

The repeated measure multivariate analysis of variance of Age (18, 24, 36, and 48 months) by Behavior (Anger, Distraction, Bid to Mother, and Focus on Gift) by Measure (Duration and Latency) revealed significant main effects (all *p*s < .001) that were qualified by significant two-, three- and four-way interactions. The predictions involving specific changes in the temporal characteristics of specific behaviors at specific ages were supported by the three-way interaction (Age * Behavior * Dynamic), $F(9, 111) = 28.12$, $p < .0005$, $\eta^2 = .53$. To understand the interaction, we compared the latency and duration for anger and each attention focus for each pair of adjacent ages. Figure 1 visually depicts overall changes in the M number of epochs to the first instance of anger expression and each form of attention focus (latency plotted as location in which bar starts) and M number of epochs for durations of anger expressions and each form of attention focus (averaged duration plotted as length of bar).

Anger latency—At 18 and 24 months, toddlers expressed anger quickly, within the first four 15 second epochs (about 1 minute) of the wait; these two age points did not differ (see Table 1). As predicted, however, latency of anger increased between ages 24 and 36 months; by 36 months children's first anger expression occurred, on average, at epoch 10, during the third minute of the wait, $t(119) = -5.30$, $p < .0001$. Also as predicted, anger latency increased between 36 and 48 months, $t(119) = -5.54$, $p < .0001$; by 48 months, on average, children did not express anger until more than half way through the wait. In sum, predicted improvements in children's latency to anger appeared between 24 and 36 months and 36 and 48 months of age.

Anger duration—Planned comparisons indicated significant decreases between each pair of adjacent ages (see Table 1). The decrease was about one 15s epoch between ages 18 and 24 months, $t(119) = 2.48$, $p < .01$, but was larger, slightly more than 4 epochs (or 1 minute), between 24 and 36 months, $t(119) = 7.58$, $p < .0001$. Between ages 36 and 48 months, there was a further decrease of about one epoch (~15 seconds; $t(119) = 4.78$, $p < .0001$). In sum, duration decreased between each pair of ages with the largest decrease between 24 and 36 months of age, as expected; the decrease in duration between 36 and 48 months, however, was modest.

Distraction latency—There was no change in latency to the first self-initiated distraction between 18 and 24 months but, as expected, children were quicker to distract themselves by age 36 months, $t(119) = 2.88$, $p < .005$, and quicker yet at 48 months, $t(119) = 4.62$, $p < .0001$. As seen in Table 2 and Figure 1, on average toddlers distracted themselves by epoch 10 (almost 3 minutes into the wait). By 36 months they distracted themselves nearer to the second minute of the wait, and by 48 months, distraction occurred in less than a minute.

Distraction duration—The duration of self-initiated distractions increased over time. No significant difference appeared between ages 18 and 24 months, but as expected, distractions were longer by 36 months, $t(119) = -2.28$, $p < .01$, and longer again at 48 months, $t(119) = -2.72$, $p < .001$. Although distractions were relatively brief at all ages, duration increased after age 24 months, averaging almost two contiguous epochs (< 30 seconds) at 18 and 24 months, nearly 2½ epochs at 36 months (> 30 seconds), and over three contiguous epochs at 48 months (> 45 seconds).

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Focus on gift latency—At all ages, children were interested in the gift before they were told they must wait to open it. Therefore, latency and duration variables for focus on the gift reflect a) how quickly children *returned* attention to the gift after mother indicated the need to wait and b) how long on average they focused on the gift when their attention returned to it.

There was an average decrease of almost three epochs (about 45 seconds) in latency between 18 and 24 months (see Table 2), but this difference was not significant. The predicted increases in latency to focus on the gift appeared, as expected, between 24 and 36 months, $t(119) = -3.16$, $p < .005$, and 36 and 48 months, $t(119) = -5.51$, $p < .0001$. At 24 months, children quickly returned their attention to the gift (in six epochs, approximately 1½ minutes), whereas by 36 months they were slower to do so (waiting about 2½ minutes). By 48 months of age they waited almost 4 minutes (11.54 epochs) before returning attention to the gift (see also Figure 1).

Focus on gift duration—In terms of duration, there were no significant differences between 18 and 24 or 24 and 36 months. The differences between each pair of time points were small < one 15s epoch. Only the decrease in duration between 36 and 48 months reached significance, $t(119) = 3.18$, $p < .005$.

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Bid about wait latency—Children's interest in getting the gift was also conveyed in their bids to their mothers. Between 18 and 24 months there was no significant change in bid latency. However, contrary to prediction, bids occurred more quickly by 36 months, $t(119) = 7.81$, $p < .0001$, and even more quickly by 48 months, $t(119) = 2.55$, $p < .005$ (see Table 3).

At 18 and 24 months, bids first occurred about two minutes into the wait; by 36 months they occurred in the first minute and by 48 months in the first 30 seconds. That is, whereas toddlers immediately returned attention to the gift, at 36 and 48 months children quickly bid to mother (see Figure 1).

Bid about wait duration—Bids decreased in length between ages 18 and 24 months, $t(119) = 2.61$, $p < .01$. They increased, but not significantly, between 24 and 36 months ($p = .10$) and increased further by 48 months but not at the set significance level of $p < .01$ ($p = .05$). As seen in Table 3, at 48 months bid duration was about what it had been at 18 months, approximately 30 seconds in length.

Changes in anger latency and duration as a function of distraction and bids

Two growth curve models, also known as multilevel models, tested whether age-related changes in distraction and bid latency and duration predicted changes in the growth curves for 1) anger latency and 2) anger duration. The maximum likelihood (ML) statistic was used to estimate model parameters and significance of random effects; the Satterthwaite method was used to estimate degrees of freedom. Because anger duration and latency can vary in both initial level and rate of change across individuals, we tested whether model fit improved with inclusion of a random intercept (i.e. variation in initial level) and slope (i.e. variation in rate of change).

Growth curve models can consider two levels. In our analysis, Level 1 (within-person level) examined intra-individual change in latency to and duration of distraction and bids. Thus, in addition to fixed effects of time (18 months = 0 months in study), time-varying distraction and bid variables, centered at the grand mean, were entered as predictors at Level 1[1]. Level 2 (between-person level) examined inter-individual variation in time-invariant distraction and bid variables (centered at each child's mean across time). Accounting for Level 2 effects is the best strategy for interpreting Level 1 effects as within-person or developmental effects (Kreft & deLeeuw, 2005; Hoffman & Stawaski, 2008).

To identify the best model, we estimated a series of models predicting latency to the first expression and average duration of anger as a function of time, latency to distraction and bidding, and duration of distraction and bidding. Intraclass correlations, calculated from baseline models including only a fixed linear effect of time and a random intercept, indicated relatively low Level 2 (between-person) variance for anger latency (REML = 687.4; AIC = 695.4; BIC = 706.6; ICC=.1615) and anger duration (REML = 216.7; AIC = 224.7; BIC = 235.9; ICC=.11), supporting the use of multi-level modeling to study intra-individual change. Next, additional time effects modeling non-linear growth (i.e. quadratic slope term) and random slopes were estimated to describe changes in a) latency to the first anger expression and b) average anger duration. Non-linear slopes were not significant and therefore omitted from Table 4.

A bottom-up approach to model building was used to examine age-related changes in anger latency and duration, in which fixed effects of time, random intercept, and slope parameters were first tested. Non-significant effects were pruned before testing conditional growth models that examined the effects of distraction and bids about the wait on age-related changes in anger expression. Interactions between fixed time-varying predictors and time were next examined before non-significant interactions were pruned. As noted, Level 2 (between-person) predictors were included to ensure that Level 1 predictors modeled only within-person effects. Only significant predictors are reported in final conditional growth models; however, non-significant Level 2 predictors were retained if they were associated with significant Level 1 predictors; this ensures that Level 1 predictors only accounted for within-person variance. Because models were nested, χ2 tests as well as the Akaike and Bayesian information criteria (AIC and BIC) were used to compare model fits.

Anger latency—The best-fitting unconditional model included a random intercept and fixed linear effect of time, indicating a linear increase over time (REML = 687.4; AIC = 695.4; BIC = 706.6). Distraction duration predicted increases in anger latency but only at older ages, estimate = .02, $t(455) = 2{,}17$, $p < .05$. Specifically, distraction duration was not related to anger latency at 18 and 24 months. However, at ages 36 (estimate = −.30, $t = -5.10$, $p < .001$) and 48 months (estimate = −.27, $t = -4.44$, $p < .001$), the longer the average distraction, the longer the child's latency to expressing anger (see Figure 2). Distraction latency did not predict anger latency. As predicted, neither bid latency nor duration predicted anger latency (see Table 5).

Anger duration—The best-fitting unconditional growth model for anger duration included a random intercept and fixed linear effect of time (REML = 199; AIC = 213; BIC = 232). Decreases in anger duration from ages 24 to 48 months were predicted by both distraction latency and average duration (Table 5). At all ages quicker and longer child-initiated distractions predicted shorter expressions of anger.

At all ages, longer bids about the wait predicted longer anger expressions. There was, however, an unexpected interaction between bid latency and time, estimate = .0063, $t(469) = 2.34$, $p < .05$. At 18 and 24 months, the quicker the toddler's first bid, the longer the anger expressions, but at 48 months quicker bids predicted *shorter* anger expressions (see Figure 3).

Follow-up analyses of bids about the wait: Age-related change in affective valence of bids

As noted, contrary to expectation, bids to engage the mother occurred more quickly with age, and quicker bids predicted longer anger expressions at 18 and 24 months but shorter expressions at 48 months. Possibly, there were changes in the affective valence of bids. To test this, we conducted a two factor repeated measure MANOVA examining age (18, 24, 36, 48 months) and bid type (calm or angry bids), distinguishing whether the child was angry or calm (i.e. neutral or happy) during the 15s epoch in which each bid occurred.

A significant interaction effect emerged, $F(2.69, 320.11) = 89.10$, $p < .001$. As seen in Figure 4, at toddler ages bids occurred mainly in epochs in which a child was angry (18 month angry bid M = 5.47 epochs versus calm bid M = 1.21; 24 month angry bid M = 3.33 versus calm bid M=1.71). However, by 36 months, bids were more than twice as likely to occur in calm (M = 5.92) than angry epochs (M = 2.29) and, by 48 months, calm bids (M = 8.73) were five times more frequent than angry bids (M = 1.67). In sum, at all ages longer bids predicted longer anger expression, but over time a) calm bids outpaced angry bids and b) by 48 months quick calm bids predicted shorter anger expressions.

Discussion

Longitudinal analyses of waiting behavior from toddler to preschool age yielded evidence of a) age-related changes in the latency and duration of how children deployed their attention and expressed anger and b) age-specific relations between these changes in temporal aspects of attention focus and anger expressions. This detailed portrait of young children's waiting behavior informs our understanding of the transitions in self-regulation during the third year of life (Kopp, 1982; 1989), supporting the view that age-related advances involve links forged between attention control and frustration tolerance (Bell & Deater-Deckard, 2007; Blair, 2002; Calkins & Bell, 2010; Posner & Rothbart, 2000).

As predicted, in the third year of life, children appeared able to sustain self-initiated distractions for longer periods and to express anger for briefer periods, which can be interpreted as quicker recovery from anger. Notably, the time it took children to initiate putative regulatory strategies also changed over time. As toddlers, children quickly conveyed anger and returned their attention to the blocked goal, initiating distractions only after a couple of minutes. However, at 36 months, the onset of behaviors had a different timing pattern. As expected, 36-month-olds quickly distracted themselves, although they soon afterward refocused on the restricted gift and expressed anger. Consistent with the view that these behavioral patterns improve with time, by 48 months, children initiated distractions even more quickly than they had at 36 months and took longer to display anger, further suggesting progress in tolerating waiting.

It is known that distractions temporarily reduce the intensity of young children's anger (e.g., Buss & Goldsmith, 1998; Gilliom et al., 2002). The present findings add to this evidence by documenting associations between self-distraction and what Thompson (1994) referred to as the "temporal dynamics" of emotion regulation. That is, children's latency to and recovery from anger were associated with their ability to distract themselves. At all ages, quicker, longer distractions were linked to briefer displays of anger. During toddlerhood (between 18 and 36 months of age), self-initiated distractions occurred more slowly and were briefer in duration than in the preschool years when distractions were both quicker and longer. Furthermore, only at preschool age (36 and 48 months) did child-initiated distractions predict *longer latency* to displaying anger. As we did not analyze temporal contingencies between strategies and anger latency and duration and therefore use contingent analyses, we cannot say that these distractions followed displays of anger or that they had an immediate effect on anger latency and duration. Rather, our emphasis was on how progress in one domain (attention control) related to progress in another domain (emotion). In sum, advances in the ability to self-distract possibly help children accept limits and forestall anger.

The age-related change in the timing of waiting-related behaviors, the increasing length of distractions, and the emergence of distraction as a strategy capable of forestalling anger reinforce the view that self-regulation reflects the *integration* of skills across psychological domains (e.g., Calkins & Keane, 2009). Taken together, the data suggest that the longer a child can sustain an *initial* distraction, the longer it takes before the child refocuses attention on the blocked goal and displays anger. The findings are consistent with the functional perspective that regards anger as both the appraisal of a blocked goal and readiness to act to regain the goal (Barrett & Campos, 1987) and the view that the emergence of effortful attention aids frustration tolerance (e.g., Carlson & Wang, 2007; Eisenberg et al., 2004; Kochanska & Knaack, 2003).

Yet, there were limits to preschool age children's tolerance for waiting. At 48 months of age, children quickly distracted themselves, but the distractions were brief (about a minute) and children also tried to engage their mothers about the demands of waiting. For instance, they remarked "How long do I have to wait?" or "This [boring] toy is broken!" Because evidence suggests that bids for support decline as children gain more autonomy in self-regulation, the finding that bids occurred as often at 48 as at 18 months was unexpected. However, the use of time-linked, independent epoch coding revealed important age differences in the affective context in which bids occurred, perhaps signaling a change in the function of bids. Toddlers' bids were more likely to occur at times when the child was angry; they objected to the wait and demanded the gift be opened. At ages 36 and 48 months, the majority of bids occurred when the child was *not* angry, despite being about the demands of the wait. This may explain why the relation of bid latency to anger duration reversed by age 48 months. In the toddler years, quicker bids were associated with longer anger, as toddlers attempted to regain the blocked goal. By 48 months, quicker bids predicted *briefer* anger. A potential explanation for the age-related reversal in the relation between bid latency and anger duration may indicate a new function of bids by age 48 months; at this age, children may have been seeking information rather than striving to get the object. Information seeking is a strategy known to regulate anger in older children (Silk et al., 2006). However, mothers and we often failed to understand toddlers' verbalizations, which precluded content analysis of bids. Coders only coded a bid if it was clearly understood that the child was bidding about the demands of waiting.

The findings are limited to a particular procedure, albeit one frequently used to study self-regulation in preschool and school age children (e.g., Gilliom et al., 2002). Most parents in our study reported that the children behaved as they usually did when required to wait. The findings are also limited to children from economically strained rural and semi-rural households, although the findings are consonant with evidence from studies of emotion regulation in middle class and in low income children (e.g., Garner & Spears, 2000).

Potentially, the use of 15 second epochs is a limitation. Studies are not uniform in the time units used (5, 10, or 15 second epochs or second by second coding); no study has indicated what effect these choices have had on conclusions. We chose 15 seconds to allow adequate time for coders to discern if a child's attention was absorbed in an alternate activity, as defined by attention research (Ruff & Capozzoli, 2003). The length of the unit of analyses might affect conclusions about average duration; for example, although it is unlikely for a focused distraction, two separate instances of a behavior could occur in one 15s epoch. However, epoch length would not affect latency data findings. Another potential limitation is the fact that we did not examine temporally *contingent sequences*, e.g., anger—strategy—anger sequences, a method that can demonstrate immediate effects of strategies on emotion (e.g., Buss & Goldsmith, 1998). Contingent sequences require second by second coding so that the timing of one behavior can be carefully related to that of another behavior. It would be useful for future studies to compare different methods to guide researchers on if and how different methods affect conclusions.

Another possible limitation is the repeated use of a task. For this reason, we asked mothers and children if the child remembered doing something similar on prior visits. No child or mother ever reported a child's remembering previous waits, perhaps because young children often have to wait. Finally, given our interest in self-regulation, the study focused only on child-initiated behavior and not mothers' behavior. Generally, mothers complied with instructions to finish their work. They did not open the gift for the child, fix the broken or boring toy, or stop returning to the work they had been asked to complete. Mothers appeared absorbed in writing their thoughts about their child's typical waiting behavior and tended to intervene only when they heard the crinkling of the wrapping paper, usually responding by reiterating the need to wait. They tended to respond briefly or ignore children's bids, including angry bids. Mothers may have behaved in these ways because they believe that handling the gift makes waiting harder and that interacting with the child interferes with mother completing her work, a topic worthy of study. Nonetheless, being ignored or being soothed by mother could influence child anger or attention focus; the dyadic transactions of parent-child interaction in this type of task can also be informative in longitudinal prediction (e.g., Cole et al., 2003).

Despite limitations, the findings highlight new perspectives on the early development of self-regulation, underscore the value of examination of temporal dynamics (e.g., Thompson, 1994), and support the view that development of self-regulation can be understood as the development of integration across domains that are often studied separately. Moreover, the findings suggest that we can promote school readiness by preparing children to forestall anger in situations they cannot control, as well as managing it when it occurs.

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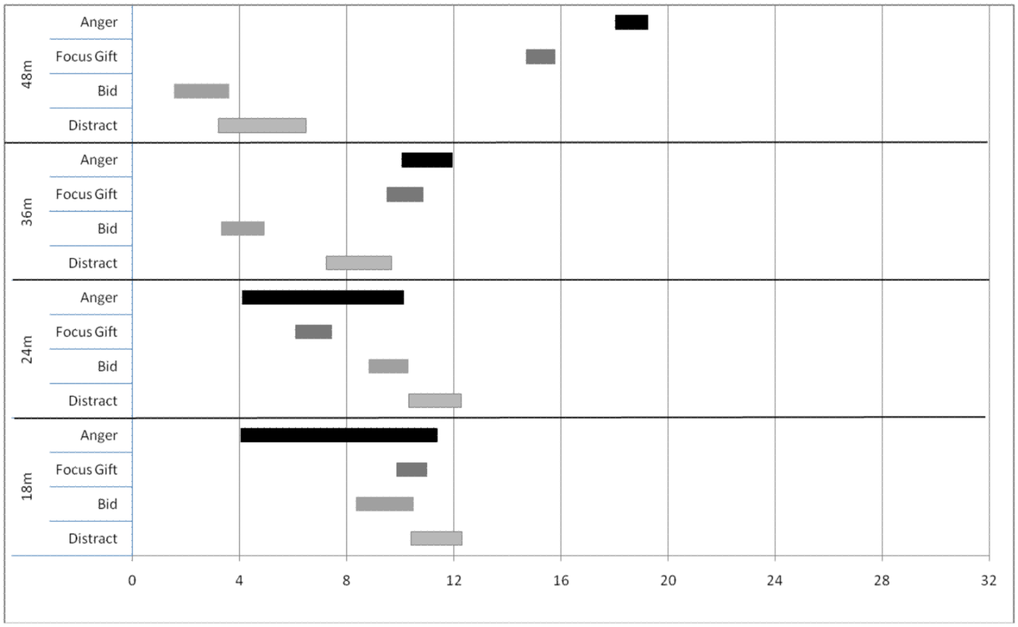

Figure 1.
Latency and average duration (in 15s epochs) of anger expression, focus on gift, bid about wait, and distraction

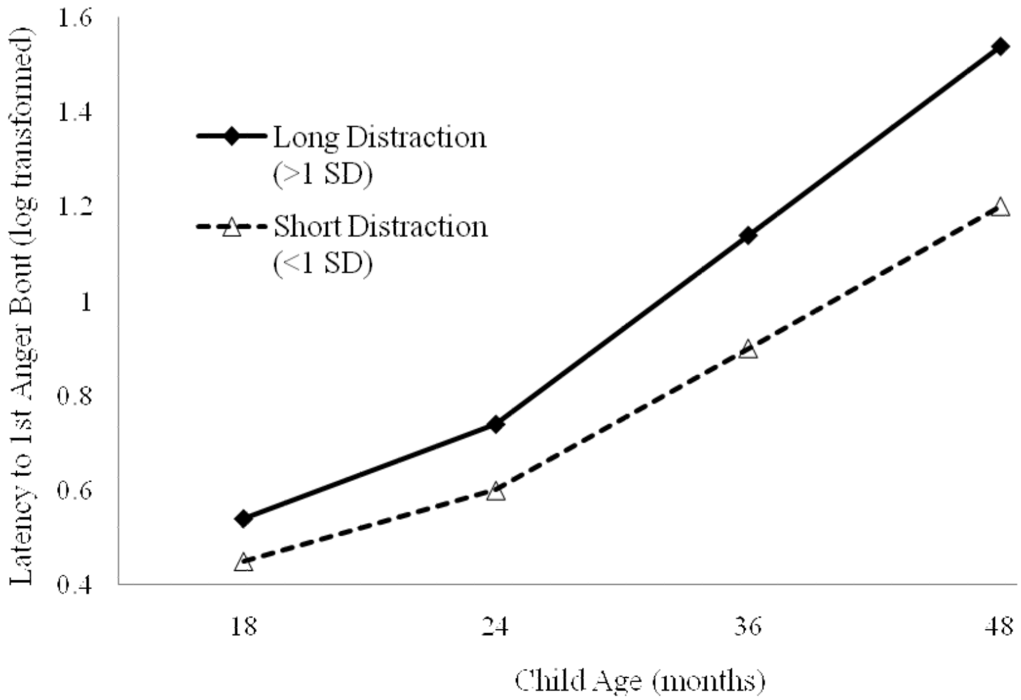

Figure 2.
Interaction of child age and distraction duration on latency to first anger expression

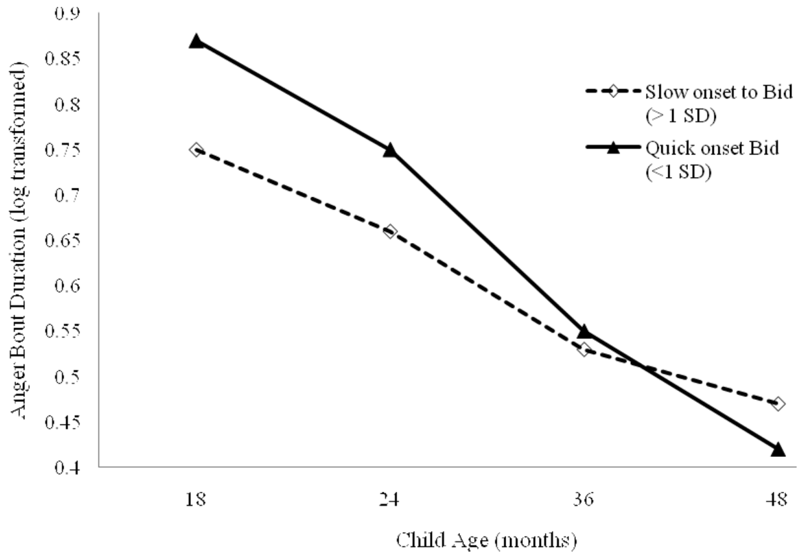

Figure 3.
Interaction of child age and bid latency on average anger duration

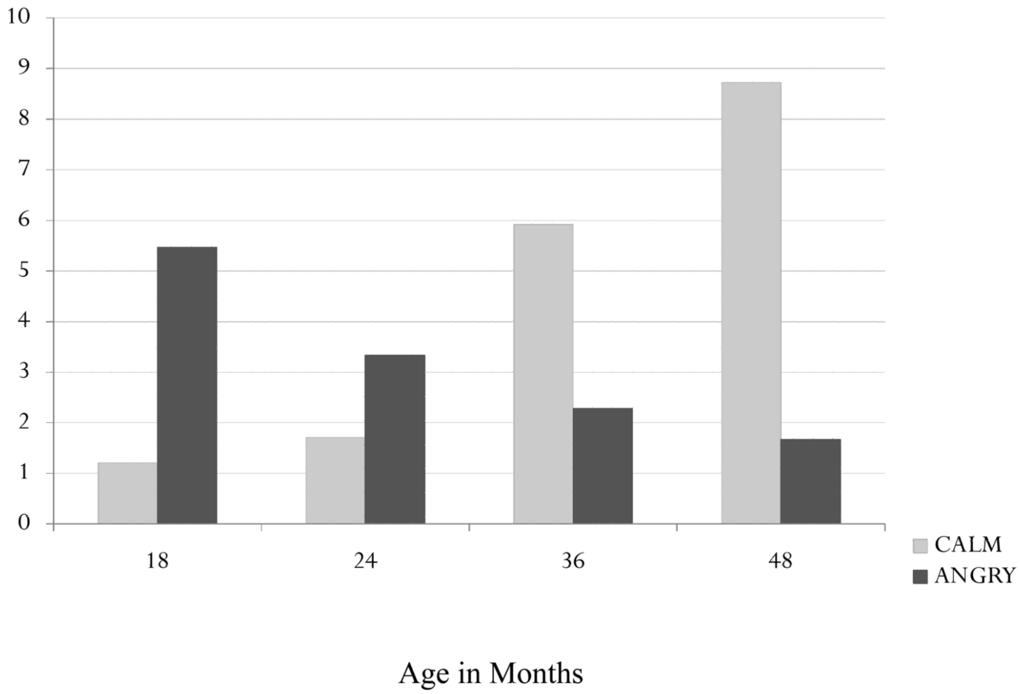

Figure 4.
Frequency of calm and angry bids about wait at each age point

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Table 1

Means and Standard Deviations for Number of Epochs to First Occurrence (Latency) and Average Number of Epochs (Duration) of Anger Expressions at Each Age Point

		Age in Months			
		18	**24**	**36**	**48**
Latency to Anger	M	4.05	4.11	10.08	18.04
	SD	6.53	7.51	11.47	12.56
Anger Duration	M	7.35	6.01	1.87	1.21
	SD	8.10	8.36	1.91	1.47

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Table 2

Means and Standard Deviations for Number of Epochs (Latency) to First Occurrence and Average Number of Epochs (Duration) of Children's Focus on Gift, Bids about Wait, and Distractions at Each Age Point

		Age in Months			
		18	**24**	**36**	**48**
Focus on Gift					
Latency	M	9.89	6.10	9.51	14.73
	SD	11.73	8.94	10.70	11.54
Duration	M	1.12	1.34	1.34	1.06
	SD	.81	.76	1.11	.86
Bids about Wait					
Latency	M	8.36	8.85	3.22	1.57
	SD	9.13	9.27	6.11	3.88
Duration	M	2.14	1.46	1.62	2.03
	SD	2.52	.93	.77	.94
Distraction					
Latency	M	10.42	10.34	7.25	3.23
	SD	10.23	9.83	8.32	4.82
Duration	M	1.90	1.95	2.44	3.26
	SD	1.43	1.40	1.92	3.24

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Table 3

Pearson correlations among anger expression and attention focus latency and duration (transformed data) at each age point

Age 18 months	**Anger**		**Focus on Gift**		**Bid about Wait**		**Distraction**	
	Latency	**Duration**	**Latency**	**Duration**	**Latency**	**Duration**	**Latency**	**Duration**
Anger Latency	--	−.51**	−.07	.10	.40**	−.06	−.19*	.14
Anger Duration		--	.01	.04	−.29**	.45**	.33**	−.30**
Gift Latency			--	−.33**	.10	.08	−.16	.09
Gift Duration				--	.23*	.35**	.26**	−.11
Bid Latency					--	−.11	−.20*	.06
Bid Duration						--	.28**	−.19*
Dist Latency							--	.33**
Dist Duration								--
Age 24 months	Anger		Focus on Gift		Bid about Wait		Distraction	
	Latency	Duration	Latency	Duration	Latency	Duration	Latency	Duration
Anger Latency	--	−.38**	.11	−.01	.26**	−.07	−.21*	.20*
Anger Duration		--	−.19*	.09	−.21*	.35**	.37**	−.46**
Gift Latency			--	−.42**	.04	−.06	−.36**	.18*
Gift Duration				--	.22*	.11	.31**	−.16
Bid Latency					--	−.33*	−.21*	.23*
Bid Duration						--	.18*	−.21*
Dist Latency							--	−.57*
Dist Duration								--
Age 36 months	Anger		Focus on Gift		Bid about Wait		Distraction	
	Latency	Duration	Latency	Duration	Latency	Duration	Latency	Duration
Anger Latency	--	−.57**	.19*	−.07	.05	−.02	−.41**	.22*

Age 18 months

	Anger		**Focus on Gift**		**Bid about Wait**		**Distraction**	
	Latency	**Duration**	**Latency**	**Duration**	**Latency**	**Duration**	**Latency**	**Duration**
Anger Duration		--	−.05	.10	.08	$.29^{**}$	$.39^{**}$	−.14
Gift Latency			--	$-.30^{**}$	−.18	$.26^{**}$	−.18	.17
Gift Duration				--	$.29^{**}$	$.29^{**}$	.15	−.00
Bid Latency					--	.15	−.03	−.03
Bid Duration						--	$.23^{*}$	−.08
Dist Latency							--	$-.28^{**}$
Dist Duration								--

Age 48 months

	Anger		Focus on Gift		Bid about Wait		Distraction	
	Latency	Duration	Latency	Duration	Latency	Duration	Latency	Duration
Anger Latency	--	$-.61^{**}$	$.27^{**}$	.03	−.08	$-.29^{**}$	−.15	$.26^{**}$
Anger Duration		--	−.14	.02	.09	$.33^{**}$	.11	$-.23^{*}$
Gift Latency			--	$-.33^{**}$	$-.18^{*}$	−.05	−.14	.15
Gift Duration				--	$.38^{**}$	$.34^{**}$	.07	.03
Bid Latency					--	$.30^{**}$	−.10	.06
Bid Duration						--	$.22^{*}$	$-.22^{*}$
Dist Latency							--	$-.27^{**}$
Dist Duration								--

Note.

* $p < .05$,

** $p < .01$

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Table 4

Baseline Growth Curve Models for Temporal Characteristics of Anger Expression

	Anger Latency			Anger Duration		
	Est	**SE**	***t* value**	**Est**	**SE**	***t* value**
Fixed effects of Time						
Intercept (age 18m)	.37	.04	9.95***	.75	.02	33.71***
Linear Time	.02	.002	12.26***	−.02	.001	−14.84***
Covariance estimates						
Intercept	.04	.01	3.14**	.01	.004	2.40**
Residual	.22	.01	13.42**	.08	.0062	13.42***
Model fit						
REML deviance	687.4			216.7		
AIC	695.4			224.7		
BIC	695.5			235.9		

Note. Est=Estimate; SE=Standard Error; AIC = Akaike's information criteria; BIC=Bayesian information criterion.

*** $p < .001$;

** $p < .01$;

* $p < .05$

Table 5

Conditional Growth Curve Model for Temporal Characteristics of Anger Expression

	Anger Latency			Anger Duration		
	Est	**SE**	***t* value**	**Est**	**SE**	***t* value**
Fixed effects of Time						
Intercept (age 18m)	.28	.14	2.00*	.68	.13	5.26***
Linear Time	.02	.002	10.15***	−.03	.004	−6.41***
Level 1 fixed effects of behavior						
Distraction duration	.20	.17	1.13	−.28	.08	−3.66**
Distraction latency		ns		.08	.04	2.32***
Bid duration		ns		.44	.07	6.27***
Bid latency		ns		−.13	.04	−3.25**
Time × distraction duration	.02	.001	2.17*		N/A	
Time × bid latency		N/A		.006	.002	2.34*
Level 2 fixed effects of behavior						
PM Distraction duration	.25	.17	.93	.0001	.15	0.00
PM Distraction latency		ns		.19	.18	1.08
PM Bid duration		ns		−.15	.16	−.97
PM Bid latency		ns		.06	.07	.40
Model fit						
REML deviance	661			78		
AIC	67			107		
BIC	675			145		

Note. Est=Estimate; SE=Standard Error; AIC = Akaike's information criteria; BIC=Bayesian information criterion. Effects listed as N/A were not included in the final models.

*** $p < .001$;

** $p < .01$;

* $p < .05$