

Background and Aims

Individual differences in self regulation of emotion have been the focus of much recent temperament research. The emergence of these early regulatory processes may have implications for cognitive development as well (Bell & Wolfe, 2004). The goal of this study was to examine the regulatory behaviors associated with cognition and emotion during infancy within the biologically-based framework of infant temperament. The general hypothesis was that individual differences in temperament, the moderating role of the environment (maternal behaviors that may contribute to self-regulation), and the regulatory processes associated with temperament (emotion) contribute to individual differences in cognitive processing. We report on preliminary findings here.

Longitudinal Methods



There were 106 mother-infant dyads who visited the research lab when the infants were 5 months old (prior to the development of regulatory processes) and 96 dyads returned for a second visit when the infants were 10 months old (when early regulatory processes begin to develop; Rothbart, Derryberry & Posner, 1994). The protocols were identical for each visit and consisted of these constructs and corresponding tasks: working memory (looking A-not-B task), emotion regulation (arm restraint and toy withdrawal), maternal interaction (toy play and peek-a-boo), and maternal report of infant temperament (IBQ-R). Infant EEG was recorded throughout each visit and power values calculated. ECG also was collected. Those data are not reported here.

Stability and Change during Infancy



Working Memory --- The looking version of the A-not-B task was used to assess spatial working memory (Bell & Adams, 1999; Bell, 2001). We coded for number of correct responses. As was expected, performance was not correlated at 5 and 10 months, $r=.02$.



Emotion Regulation --- Infant regulation was assessed during the arm restraint task and the toy withdrawal task. We coded for self comforting, mother orientation, distraction, object orientation, and scanning (Calkins et al., 2002). As expected, regulatory skills were not correlated at 5 and 10 months, all r 's $<.03$.



Maternal Interaction --- Maternal interaction was assessed during toy play and peek-a-boo. We coded for sensitivity, intrusiveness, physical stimulation, and facilitation of attention (Calkins & Johnson, 1998). Mothers were highly consistent in their behaviors at the 5- and 10-month lab visits, r 's = .26-.55.

Infant Temperament --- Rothbart's IBQ-R was completed by the mothers when infants were 5 months and 10 months of age. Mothers were highly consistent in rating their infants' behaviors (i.e., infant temperament was stable from 5 to 10 months). Intercorrelations between temperament scales at the two ages ranged from .37 to .60.

Thus, maternal reports/behaviors were consistent, but infant behaviors changed across time. This developmental change was expected, as 10 months is a crucial time not only for the beginnings of regulatory processes, but also for developmental changes in working memory skills.

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Correlates of WM Performance

Working memory performance was low at the 5-month assessment, with 44% of the infants failing to look toward the correct hiding location on any trial. These factors were associated with working memory performance at **5 months**:

EEG during WM task	Emotion Regulation	Maternal Interaction	Infant Temperament
P3 (parietal) $r = .20$	Scanning $r = -.25$	Facilitates attention $r = -.21$ Physical stimulation $r = .30$	Soothability $r = -.49$ Falling reactivity $r = -.48$

At 10 months, working memory performance increased such that 90% of the infants were successful in looking toward the correct hiding site during some portion of test trials. Preliminary analyses revealed that these factors were associated with working memory performance at **10 months**:

EEG during WM task	Emotion Regulation	Maternal Interaction	Infant Temperament
F2, F8 (frontal) $r = -.21, -.16$ T4 (temporal) $r = -.21$ P3, P4 (parietal) $r = -.26, -.28$	Scanning $r = -.24$	Physical stimulation $r = -.26$	Distress $r = .19$ Falling reactivity $r = -.21$

These 10-month EEG data and temperament data replicate our previous infant work (Bell, 2001, 2002; Bell & Wolfe, in press; Bell, under review).

Conclusions

These preliminary data give beginning support to the idea that there are interactions between regulatory behaviors and cognition as early as the first year and that these associations change from 5 to 10 months of age. Our next task is to do model testing associated with the general hypothesis of the study.