INTRODUCTION

Infants blink spontaneously (SB) at very low rates\(^1\)\(^-\)\(^2\) compared to adults\(^3\) and individual differences are wide. The mechanisms underlying the developmental increase in the rate of SB, the wide individual differences in SB rate, and the malleability of SB rate are not well understood.

However, we know that the central dopamine system plays a role in the regulation of SB. For example, dopamine (DA) agonists increase the rate of SB\(^4\), and antagonists drugs decrease SB\(^5\). Moreover, patients with disorders known to involve DA often show altered SB rates\(^6\),\(^7\),\(^8\). Additionally, theoretical arguments and empirical findings\(^9\) suggest that central DA system function may underlie some dimensions of personality (i.e., extraversion).

The present analyses focus on the relationship between SB and dimensions of temperament in infants\(^10\),\(^11\). We investigated (a) individual differences in SB rate and the stability of individual differences from 4 to 12 mo, and (b) developmental change in SB with respect to dimensions of temperament. These analyses test the hypothesis that the rate of SB may be linked to some aspects of temperament. Results of this work may contribute to increased understanding of the biological bases of temperament.

METHODS

Participants

Participants to-date were full-term infants (N=20; 10 female) who were observed at 4 mo (117 ± 8 days) and at 12 mo (368 ± 7 days). High and low blinkers did not differ on age, birth weight, weight at 4 months, weight at 12 months, number of siblings at home, hours since last feeding, infant of home care-giving, time of day observed. Groups did not differ in baseline SB at 4 mo or at 12 mo nor did they differ on the factors listed in the previous statement.

RESEARCH QUESTIONS

- What are individual differences in the rate of SB like at 4 and 12 months?
- Are the individual differences in the rate of SB stable from 4 to 12 months?
- Is the rate of SB linked to temperament measures (at either age)?
- Are there developmental changes in SB and temperament from 4 to 12 months?
- Are developmental changes in SB related to dimensions of temperament?

Design and Procedures

Infants at both ages were observed during three phases (Figure 1): baseline, stimulus condition, temperament tests. After baseline (6 min), infants were observed during a moving or social stimulus condition (4-6 min). The moving stimulus condition was designed to test whether blinking rate is reduced during visual tracking tasks in infants as observed in adults. The moving stimuli were toys (~ 5 x 8") that were presented (~55° from baby) one at a time for 30 s (4 mo) or 15 s (12 mo) to elicit visual attention. The social stimulus condition was designed to test the hypothesis that the rate of blinking would increase during social interaction. Social stimulus conditions were different for 4 and 12 mo. At 4 mo, infants were engaged socially as the experimenter read a story in an interactive way. At 12 mo, infants were engaged using two hand puppets who talked to the baby and with each other. Story lines for the puppets were scripted.

RESULTS

Background factors and sex differences

None of the following variables were related to baseline SB: age, birth weight, weight at 4 months, weight at 12 months, number of siblings at home, times since last feeding, times of day in lab, stimulus type, care-giving (infant of home). Sex differences were found in the rate of SB at 12 mo but not at 4 mo; F(1,18)=14.5, p=0.001. This difference likely resulted from the sample selected for this analysis (Figure 2). At 4 mo (N=10) showed no sex differences. The tendency toward stable individual differences from 4 to 12 mo suggests that when the sample is complete at 12 mo, no sex differences will be found.

Individual differences in rate of SB

Individual differences in baseline SB rate were wide at both ages: 4 mo, 1.3 to 8.4 blinks/min; at 12 mo, 0.7 to 8.7 blinks/min (N=20) Figure 2.

The ranges of rates observed were similar at both ages; however, at 4 mo, lower blink rates (near 2 blinks/min) were more frequent.
Developmental Changes
Stability of individual differences from 4 to 12 months
Of the 6 highest blinking infants at 4 mo, 4 of those remained among the highest blinkers at 12 mo. Of the 8 infants who blinked at middle rates (~3-5 blinks/min), 5 of those remained in the middle at 12 mo. Of the 6 infants who blinked at the lowest rates at 4 mo, 4 of those remained among the infants with the lowest rates of SB at 12 mo (Figure 3, right). This pattern suggests modest stability of individual differences.

Rate of SB
The baseline rate of SB increased from 4 to 12 mo, however, the effect of the stimulus presentation differs at the two ages (Figure 4, below). Note that while group effects were found, the patterns for individual infants vary (Figure 3, right).

Developmental Changes
Individual Differences in SB
Individual differences in the rate of spontaneous eye blinking were wide at both ages (highest rate was 8 times that of the lowest), and the rate of spontaneous eye blinking tended to increase during the second half of the first year. Moreover, individual differences in the rate of SB from 4-12 months or (b) the baseline blinking rate at 12 months (*Activity level, Duration of orienting, Smiling/Laughter, Approach).

Rate of spontaneous blinking and dimensions of temperament
Infants at 12 mo whose rate of blinking increased from 4 to 12 mo had exhibited fewer approach behaviors to nearby toys than those whose SB rate did not increase. F(1,18)=11.5, p<.003 (Figure 5, below). This difference was more marked for high stimulus toys. No IBQ-R subscale analyzed to-date was related to (a) change in SB from 4-12 months or (b) the baseline blinking rate at 12 months (*Activity level, Duration of orienting, Smiling/Laughter, Approach).

Toddlers' approach-inhibition in toddlers: Prediction from infancy, positive and negative affective components, and relations with behavior problems. Child Development.

DISCUSSION
Individual Differences in SB
Individual differences in the rate of spontaneous eye blinking were wide at both ages (highest rate was 8 times that of the lowest), and the rate of spontaneous eye blinking tended to increase during the second half of the first year. Moreover, individual differences in the rate of SB from 4 to 12 months were relatively stable. However, not all infants showed a developmental increase in SB rate during this period.

Developmental Changes
Most of the behaviors observed showed developmental change across this 8 month period. Lab observations documented increased approach behaviors toward nearby objects and an increase in the rate of spontaneous blinking for the group. Parents responses to the IBQ-R revealed increases in their infants’ activity level, fear, smiling, and vocal reactivity (among others). Developmental changes in blinking rate were linked to infants’ approach behavior. Specifically, infants whose rate of SB increased between 4 and 12 mo exhibited fewer approach behaviors during the laboratory observation at 12 mo than infants who did not show a substantial increase in SB (or whose rate decreased). The difference was most marked for high intensity objects. This suggests that the developmental increase in SB may be associated with the emergence inhibitory tendencies that also appear during the second half of the first year.

REFERENCES