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Temperament and Sleep-Wake Behaviors from Infancy to Toddlerhood

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Abstract

Sleep-wake behaviors and temperament were examined longitudinally for trait stability and relationship to behavioral state regulation from infancy to early childhood. Subjects were 120 low-risk, full-term infants from a middle class sample. At 6 weeks, parents completed 3 consecutive days of the Baby's Day Diary which measures sleep, wake, fuss, feed and cry states and the Infant Characteristics Questionnaire. At 16 months, parents assessed sleep behaviors with the Sleep Habits Inventory and temperament with the Toddler Symptom Checklist. At 24 months, parents repeated 3 days of the Baby's Day Diary. Structural Equation Modeling was used to examine cross-age hypotheses for sleep-wake and temperament associations. From early infancy to toddlerhood, sleep-wake behaviors and irritable temperament were notably stable but independent in this cohort.

Keywords

Sleep; wake; infant; toddler; temperament; continuity; fuss; diary method; longitudinal

Individual variability in sleep-wake behavior problems has been linked to temperamental style through hypothesized shared CNS arousal regulatory processes (Dahl, 2005). In the first two years of life, night-time awakenings become fewer and briefer (Louis, Cannard, Bastuji, & Challamel, 1997), and sleep consolidation develops rapidly in most infants (Burnham, Goodlin-Jones, Gaylor, & Anders, 2002). Individual differences in the maturation and course of infant to early childhood sleep development have been linked to temperament (Kataria, Swanson, & Trevathan, 1987), (Scher, Tirosh, & Lavie, 1998), parent-child relations (Anders, Halpern, & Hua, 1992), parental cognition (Morrell & Steele, 2003), (Sadeh, Flint-Ofir, Tirosh, & Tikotzky, 2007), and the sociocultural milieu (Fukumizu, Kaga, Kohyama, & Hayes, 2005; Owens, 2005).

In school-age children, daytime behavioral problems and sleep disturbance have been associated in many studies (Hayes, Parker, Sallinen, & Davare, 2001; Owens-Stively, et al., 1997; Sadeh, Gruber, & Raviv, 2002), and are retrospectively linked to difficult temperament in infancy (Pettit, Bates, Goodnight, Staples, & Dodge 2007). Child resistance to parental proscriptions for bedtime is commonly reported (Zuckerman, Stevenson, & Bailey, 1987); however, the development of sleep self-regulation has been most strongly related to parental practices, e.g. consistency in bedtime routine, training independence

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during wake to sleep transitions, and reduced parental proximity during sleep (Adair, Zuckerman, Baucher, Philipp, & Levenson, 1992; Anders, 1978; Hayes, Roberts, & Stowe, 1996).

Once established, child sleep disturbance is difficult to modify. Infants, who have sleep problems at 8 months of age, commonly continue to have problems at 3 and 4 years of age (Wolke, Meyer, Ohrt, & Riegel, 1995). In a longitudinal study from infancy to 2 years, Gaylor, Burnham, Goodlin-Jones and Anders (2005) reported a decline in night waking with age, and decreased need for parental presence at sleep onset, but no change in the resolution of sleep onset difficulties or need for parental reunions during the night.

The interface of child temperament, parental interactions and sleep is complex and poorly understood (Super & Harkness, 2002). Temperamental style is modified by the attachment relationship and other socializing experiences that may expand or suppress predisposing psychobiological biases (O'Connor et al., 2007; Rothbart & Ahadi, 1994; Scher, 2008). Second, it is difficult to identify cross-age measures that reflect homologous temperament dimensions to those tapped by infancy constructs (Seifer, Sameroff, Dickstein, Schiller, & Hayden, 2004). Further, temperament findings are different when based on home vs. laboratory observations. Hane, Fox, Polak-Toste, Ghera, & Guner (2006) found that maternal ratings of infant negative emotionality converged with observers in the home context but not in the laboratory. Validated parental reports in conjunction with objective measures can provide cross-validation within the same study (Goodnight, et al., 2007; Seifer, et al., 2004).

Behavioral states assessed by parental home observations have yielded interesting individual differences in both the rate and temporal distribution of crying and fuss states. Behavioral states, such as fussiness, correlate with maternal perceptions of negative or difficult temperament assessed through validated instruments such as the Infant Characteristics Questionnaire (St. James-Roberts, Conroy, & Wilsher, 1998). For the present study, we used home-based behavioral state estimates, including sleep-wake behaviors, to compare to parental perceptions of child temperament and sleep development over the first two years of life. Individual differences in home-based behavioral states (e.g. sleep, feeding, awake and content, fuss and cry) and parent ratings of sleep habits and temperament were compared to address the hypothesis that behavioral state regulation and difficult temperament are stable across age, and associated with sleep disturbance during early development.

Method

Participants

Mothers were identified during mid-pregnancy and enrolled as part of a larger longitudinal project focused on prenatal development. The study was approved by the institution's IRB board and informed consent was obtained from all participants. Eligibility was restricted to pregnant women with low-risk, singleton pregnancies and healthy full-term infants. One hundred-seventy-two infants were originally recruited for participation, and at 6 weeks, 161 returned for the 6 week follow-up. Of these, 33 were excluded for pre- or postnatal complications, including prematurity. Infant data that did not include at least two time points were excluded, leaving a final sample of 120 infants.

The families that participated in this study were predominantly middle class, with 115 reporting household annual income of more than $40,000, 3 reporting between the range of $30,000-$40,000, and 2 between $20,000 and $30,000. A racial/ethnic breakdown of mothers showed that 88% of participants were European American, 9% African American, and 3% Asian American. Fifty-two percent of infants were male and 57% were firstborn.

The average maternal age at study enrollment was 31.6 years (*SD* = 3.8). Mean parental education was 16.5 (*SD* = 2.3) years for mothers and 15.7 (*SD*= 2.5) years for fathers. Most infants in the sample were breastfeeding (83.2%) for ≥ 75% of the feeds. Most mothers reported work plans of ≥ 30 h per week (78%).

Instruments

Infant Characteristics Questionnaire (ICQ 6; Bates, Freeland, & Lounsbury, 1979), is based on early temperament research (Thomas, Chess, Birch, Hertzig, & Korn, 1963), and was chosen for high test-retest reliability, internal consistency (Hubert, Wachs, Peters-Martin, & Gandour, 1982) and focus on difficult temperament. Twenty-four items on a seven-point Likert scale, with 1 as the optimal score for positive temperamental traits. Four validated ICQ factors yield sub-scores of difficult-fussy (Cronbach alpha=0.79), unadaptability (0.75), dull (0.39) and unpredictable (0.50) and a composite difficultness score (Bates et al., 1979). Although this instrument has been normed on 6 month old infants, the current study used it at 6 weeks. It has been used in infants as young as 1-3 months (McGrath, Boukydis & Lester, 1993; Feldman, Eidelman, Sirota & Weller, 2002; Schoppe-Sullivan, Mangelsdorf, Brown & Sokolowski, 2007).

Baby's Day Diary (St. James-Roberts & Plewis, 1996) has been validated through the use of videotape and voice-activated audiotape recordings. Sleeping, awake & content, fuss, crying, and feeding are mutually exclusive states. Crying was defined for parents as "periods of prolonged, distressed vocalizations" andfuss was defined as a state when "the baby is unsettled, irritable, or fractious and may be vocalizing but is not continuously crying" (St. James-Roberts & Plewis, 1996). Correlations between maternal report of infant sleep behavior using the baby day diary and objective measures of infant sleep using video and audio recordings ranged from .6-.7 (Minde, Popiel, Leos & Falkner, 1993; Barr, Kramer & Boisjoly, 1988). A 24-hour bar graph template, simulating a measurement ruler, is filled in based on the time in minutes. For the 6-week measurement, states were divided into 4 time periods (12am-6am, 6am-12pm, 12pm-6pm, 6pm-12am). Reliability is improved by averaging to yield mean duration of each behavioral state in minutes per 24 h period.

Sleep Habits Inventory (Crowell, Keener, Ginsburg, & Anders, 1987) examines nighttime behaviors, parental guidelines for bedtime and rise-time, night-waking, the presence of sleep problems, ease of sleep onset, use of sleep aids, etc., during the past week using a Likert-style format (1=not this week, 2=1to 2 times this week, 3=3 to 5 times this week, and 4=6 or more times this week). The inventory samples the past week and has been found to be representative of the child's current sleep patterns (Hayes, et al., 2001).

*Infant/Toddler Symptom Checklist c*orrectly identified infants and toddlers with regulatory disorders between 86-100% of the time depending on age (Degangi, Poisson, Sickel, & Wiener, 1995). Caregivers were asked how often: the child is fussy or irritable; the child goes easily from a whimper to an intense cry; the child demands attention and company constantly; the child wakes up three or more times at night and is unable to go back to sleep; the child needs a lot of help to fall asleep; the child is startled or upset by loud sounds; and the child is unable to wait for food or toys without crying or whining. For each item, the child is rated as never fit the description (0); used to fit the description (1); sometimes fit the description (2); or fit the description most of the time(3). The scores for each item are summed. TSC subscale scores include self regulation, attention, and attachment/emotional functioning.

Procedure

Parents and their infants participated in this study by visits to the laboratory and home assessments described for each age below.

Infant (6-weeks)

The Infant Characteristics Questionnaire (ICQ) was mailed home in separate envelopes labeled “Mom” and “Dad” with instructions to parents to fill out each questionnaire independently. At 6-weeks, mothers and infants visited the laboratory and were instructed on procedures for determining their infant’s behavioral state data over a 3-day period using the Baby’s Day Diary. Infants were observed for 3 days consecutively in the home. Mothers and fathers were responsible for the estimates.

Toddler (16-months)

Parents were interviewed over the phone using the Sleep Habits Inventory (SHI), an instrument for evaluating sleep in toddler age children (Crowell et al., 1987). Mothers were asked to estimate sleep event occurrences during the past week. In addition, mothers were asked to answer questions from the Infant/Toddler Symptom Checklist (TSC; DeGangi et al., 1995) for toddler regulatory behaviors and temperament.

Early Child (24-months)

At 24 months, parents were contacted and instructed to perform a second Baby’s Day Diary. The frequency, duration (total, maximum and minimum) for each behavioral state category was tabulated for each 24 hour period.

Data Analysis

Pearson correlations and regression were applied within and cross-age. Chi Square was applied to compare frequencies. Structural Equation Modeling (SEM) was used to examine cross-age hypotheses for stability in sleep-wake and temperament behaviors. AMOS™ software version 7.0 was used for the SEM analyses. SPSS™ was used for all other analyses. The diaries were analyzed at the Thomas Coram Research Unit, Institute of Education, University of London.

Results

Infant (6-weeks)

Table 1 shows the 6-wk ICQ factors and composite score means and standard deviations for mothers and fathers. Maternal and paternal ratings strongly concurred for the composite difficultness score (r =.79, p<.0001) and the difficult-fussy subscore factor (r =.52; p<.0001). ICQ averages computed across parents revealed that the composite score correlated significantly with the 24 hour fuss average of the Baby’s Day Diary (r=0.29, p<.003), as did the ICQ difficult/fussy factor (r=0.52, p<.001). A detailed comparison of mother vs. father ICQ ratings and objective measures of infant temperament and parental psychological status in this cohort is provided in Atella, DiPietro, Smith, & St. James-Roberts (2003).

For 6-wk sleep, parents reported that the modal infant sleep position was supine (57%), followed by side (32%); other positions were rarely used. Behavioral states derived from the Baby’s Day Diaries were examined with Pearson’s correlations for relevant sleep-wake and state behavior stability based on the circadian day divided into four six-hour periods. Diary data were available for 106 (88%) participants; 3-day records were available for most (82%) infants; 5 (4%) and 16 (14%) had either one or two days respectively. All of the 6-week infants were cared for at home at this age. There were 2 or 3 days of recordings in 96% of all records.

Midnight to 6 A.M.—The proportion of sleep, wakefulness and other states between midnight-6 A.M were examined. Sleep was negatively correlated with behavioral state durations of fuss ($r = -0.54$, $p = .001$) and feeding ($r = -.70$, $p = .001$) during the night period. The 24 h composite of awake & content correlated with awake & content across the four circadian time periods *except* midnight to 6 A.M. which showed high variability (6 A.M.-midday, $r = 0.72$, $p = .001$; midday-6 P.M, $r = 0.74$, $p = .001$; 6 P.M.-midnight $r = 0.64$, $p = .001$; midnight to 6 A.M., $r = 0.21$ p = ns).

6 A.M. to Midday—The 24 h total durations of awake & content and sleep were negatively correlated (r = −0.52, $p = .001$); however, within the 4 time periods, awake & content at 6am-midday was unique in that it was the only time period to correlate significantly and negatively with the 24 h sleep composite (r = −0.50, $p = .001$).

Toddler (16-months)

Nocturnal sleeping arrangements and the distribution of sleep during the circadian day revealed that the modal sleep arrangement was *own room with crib* (84.8%); one parent endorsed *bedsharing with the parents,* although (5%) slept *in a crib in the parents room*. Toddlers showed typical total sleep time (TST), ($M = 645$; $SD = 42$ min), naps frequency ($M = 1.26$, SD=.42) and duration (M= 131; SD=44 min).

Child (24-months)

The Baby's Day Diary data were used for cross-age comparisons of diary behavioral states at 6-weeks and 24-months in the analyses below.

Continuity of State Behaviors from the Diary Method—In the comparison of trait stability across age, the 6-week and 24-month diary state categories are shown in Figure 1 for comparison of the 24 h composites. Significant decline in the average 24 h state durations were observed in all states, except for awake and content which increased. In constructing a quantitative model of individual cross-age stability, each state behavior was examined separately. Figure 2 plots correlations between 24-months state behaviors and the corresponding 6-weeks state behaviors for the four periods of the day. Significant correlations are shown in filled circles with positive and negative correlations shown to the right vs. left respectively. Awake & content and fuss states, but not the other state behaviors, show correlative stability from 6-weeks to 2 years of age.

Longitudinal Analyses

Our approach to statistical analysis of the cross-age measures relied on Structural Equation Modeling (SEM). Cross-age interactions of sleep-wake behaviors and temperament were tested with models derived from developmental hypotheses proposed from the original correlational associations.

Table 2 shows the definitions for the latent variables used in the Structural Equation Modeling and Table 3 lists the means, standard errors and correlations for the variables used. As displayed in Figure 3, the latent variable *wakefulness at 6-weeks* (comprised of awake & content 6 A.M.-12 P.M., 12 P.M.-6 P.M. and 6 P.M.-12 A.M.) was a significant predictor (β = .50, p = .002) of wakefulness at 24 months (comprised of awake & content average duration, maximum duration and minimum duration). The model fits the data well, χ^2 (8) = 8.63, $p = .374$, TLI= .983, CFI = .993, RMSEA=.03. Akaike's Information Criterion (AIC) indicates that this model is strongly favored over a saturated model (ΔAIC = 7.37) and very strongly favored over an independence model (ΔAIC = 81.74) (Burnham & Anderson, 1998).

Continuity of Infant Temperament—Figure 2 shows the two states: fuss and awake & content at 6 weeks and 24 months are stable longitudinally using a correlation analysis. Infant fuss and awake & content were predictive of 24-months measures for the daytime periods. But, the 24 hour composite was a similarly strong correlative.

Figure 4 shows the SEM latent variable analysis for the temperamental state of *fuss* and was constructed using Baby's Day Diary data at 6 weeks compared to the 24 months fuss, and the 16 month TSC parental report. The latent variable *fuss at 6 weeks* is comprised of fuss state from 6 A.M.-12 P.M. and 12 P.M.-6 P.M. F*uss at 16 months* is comprised of TSC subscales: self regulation, attention, and attachment/emotional functioning. *Fuss at 24 months* is comprised of the fuss maximum duration and frequency parameters over 24 hours. Table 2 defines the measures used at each age for the fuss latent variable. Table 4.shows the means, standard errors and correlations for each measure contributing to fuss latent variables. As shown in the SEM solution in Figure 4, the *6 week fuss* latent variable was a significant predictor of both *fuss at 16 months* (β =.72, p = .001) and *fuss at 24 months* (β =. 54, p = .05). The model fits the data well, $\chi^2(11) = 12.34$, p = .339, TLI=.971, CFI = .989, RMSEA=.03. By Akaike's Information Criterion (AIC) the model was very strongly favored over a saturated model (ΔAIC = 9.66) and over an independence model (ΔAIC = 99.67) (Burnham & Anderson, 1998). A path between the latent variables of fuss at 16 months and fuss at 24 months was examined and found to not be significant. When the model fit was compared between models using a Chi Square difference test, no significant change was found, χ^2 (1) = 1.7, p = *ns*, thus the more parsimonious model is presented.

Discussion

St. James-Roberts and Plewis (1996) reported that fuss and sleep were the most stable individual characteristics of infant behavior in the first 9 months. Our longitudinal study of healthy, middle class infants examined stability from 6 weeks to 24 months in arousal regulatory properties of sleep, wake and fuss behavioral states, and found additional evidence for cross-age individual stability. Our simple correlational analysis found that awake and content and fuss derived from the Baby's Day Diary were stable from 6 week to 24 month ages, especially when examining full day and daytime blocks at 6 weeks. The antagonistic relationship found between 24 h sleep and awake & content between 6 A.M. to midday suggests that rates of wakefulness in the early daylight period reflect homeostatic sleep drive.

Using the SEM approach, the 6 week latent variable, wakefulness (constructed by parental scores on awake and content for all time blocks except 12 A.M. to 6 A.M), predicted wakefulness at 24 months (constructed from duration measures). Interestingly, nocturnal wakefulness between 12 A.M. and 6 A.M. did not predict individual differences, perhaps, because homeostatic sleep drive is greatest at that time. Alternatively, parents are probably less aware of quiet waking during the midnight to 6 A.M. circadian time when they are likely sleeping. Nonetheless, these findings from a low risk, healthy cohort argue that daytime wakefulness regulatory properties may be emergent in the neonatal period and phenotypic, as has been found for animal models (Dugovic & Turek, 2001; Toyota, et al., 2001), and in adults, where individual differences in sleep-wake parameters are stable, and sleep drive and disorders have strong familial association (Gottlieb, O'Connor, & Wilk, 2007).

In toddlerhood, sleep regulation has been established in most children although night waking may recur (Scher & Cohen, 2005), or still be unresolved (Fukumizu, et al., 2005). Sleep regulation is strongly promoted as a developmental milestone by parents, and is related to parental practices regarding parent-child sleep proximity during infancy (Hayes, Robert, & Stowe, 1996; Hayes, Fukumizu, Troese, Sallinen, & Gilles, 2007). In the current study, parental sleep practices and co-sleeping or night-time proximity to the parents' bed at 16 months were found to be unrelated to infant temperament or sleep problems. Neither the parent-scored state diary nor parent temperament ratings (i.e. ICQ, TSC) showed a simple relationship to the 16 month sleep habits measured by the SHI. One reason may be that parental sleep practices are not as strongly established or consistent in this developmental window from infancy to toddlerhood as they may be during later childhood. Thus, the link previously found between sleep hygiene, sleep problems and temperament during early childhood and among older children may not yet be evident. Another possibility, and potential limitation, may be the homogeneity of the cohort which was selected for optimal health and family resources. Such middle class, married families likely share very similar sleep practices, as evidenced by the exceptionally low variability in the SHI data at 16 months. Hence, these factors may have limited our ability to detect relationships between temperament and sleep disturbance at 16 months. The optimality of the sample included high rates of breastfeeding and exclusion for infant perinatal reproductive risk which is not typical of community samples. Hence, in the present study the independence of temperament and sleep measures is compelling because the findings cannot be easily attributed to individual differences in child environment or health.

We found that continuity in the temperament dimension of fuss from infancy to 2 years of age was reasonably conserved with the measures used, and this finding refutes the view that early temperament is unstable due to neurodevelopmental affective immaturity (Rothbart, Ahadai, & Evans, 2000). The methodological convergence of the 6 week ICQ and naturalistic diary observations for fuss, as well as the SEM fuss latent variables for 6 week vs. 16 months and 24 months, supports the idea that fuss, but not crying, is stable in early development. As a temperamental trait, fuss may share construct validity with laboratory measures of negative affect (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984) and proposed companion psychobiological markers (Davidson, 1992; Davidson, 2001). Importantly, in the fuss SEM analysis, 16 month TSC parental report was predicted by 6 week fuss, but the path was not conserved when 16 months was used to predict 24 month fuss in the SEM model. The 16 month fuss latent variable, constructed from TSC factors attention, self regulation and attachment/emotional functioning symptoms, while predicted by 6 week fuss, may be associating with somewhat different temperamental features than that linking 6 week fuss and fuss at 24 months. The infant fuss SEM latent variable is a reliable link to fuss temperament at both 16 months and 24 months and is therefore a potentially strong predictive marker for a temperamental difficultness trajectory within this developmental timeframe.

These results also suggest that sleep drive exhibits trait-like properties early on that are stable up to two years of age. Hence, individual differences in temperamental style and sleep-wake inclination are evident from infancy, but the interaction of these constructs was not found in any of the models that were tested, and, therefore, we cannot confirm the temperament–sleep association in this sample for these ages.

An important limitation of the study is that all of the measures used were based on parental reports which may be influenced by parental perceptions and biases. Several studies have suggested that maternal stress and anxiety during pregnancy are associated with parental reports of child sleep problems and difficult/fussy temperament in early development (DiPietro, Ghera & Costigan, 2008; O'Connor, et al., 2007). In the previous report on this cohort, parents concurred on 6-week assessments for fuss and ICQ composite scores although paternal, but not maternal, psychological distress contributed significantly to the ratings. Mothers' ratings were more influenced by infant behavioral states (Atella, et al., 2003). In the present study, maternal ICQ ratings were used for the SEM analyses. The Baby's Day Diary method has been previously validated through the use of videotapes and voice activated recorders (St. James-Roberts & Plewis, 1996), and infant difficult temperament is only modestly affected by parental stress with this measure (Darnaudéry, Dutirez, Viltart, Morley-Fletcher, Maccari, 2004).

Further work on the sleep-temperament association is needed which uses the prospective longitudinal method and child observations that combine home, laboratory and validated parental assessments in both community and high-risk samples.

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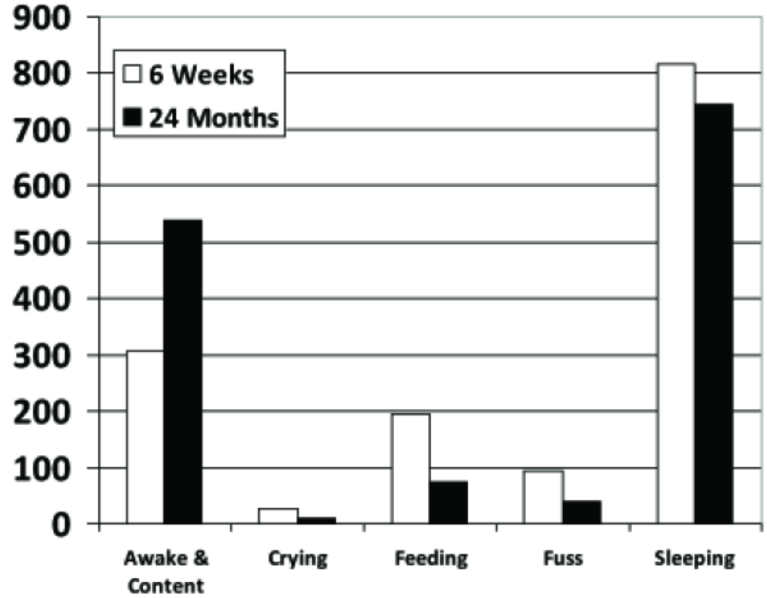
900
800
700
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100
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6 Weeks
24 Months
Awake & Content
Crying
Feeding
Fuss
Sleeping

Figure 1.

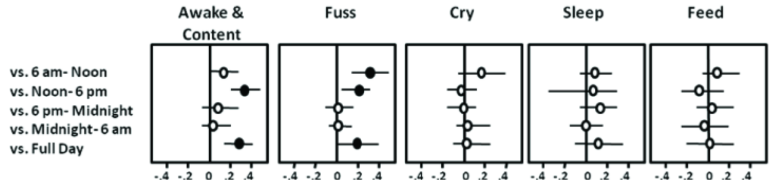
Awake & Content
Fuss
Cry
Sleep
Feed
vs. 6 am- Noon
vs. Noon- 6 pm
vs. 6 pm- Midnight
vs. Midnight- 6 am
vs. Full Day
-.4 -.2 0 .2 .4

Figure 2.

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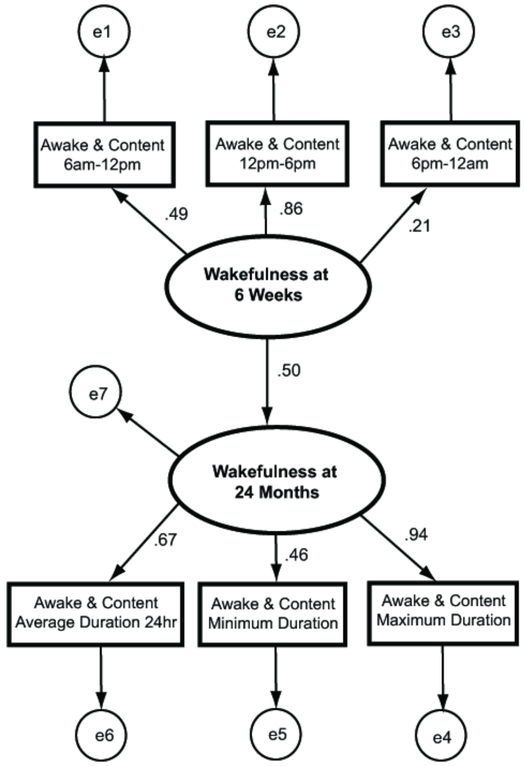

Figure 3.

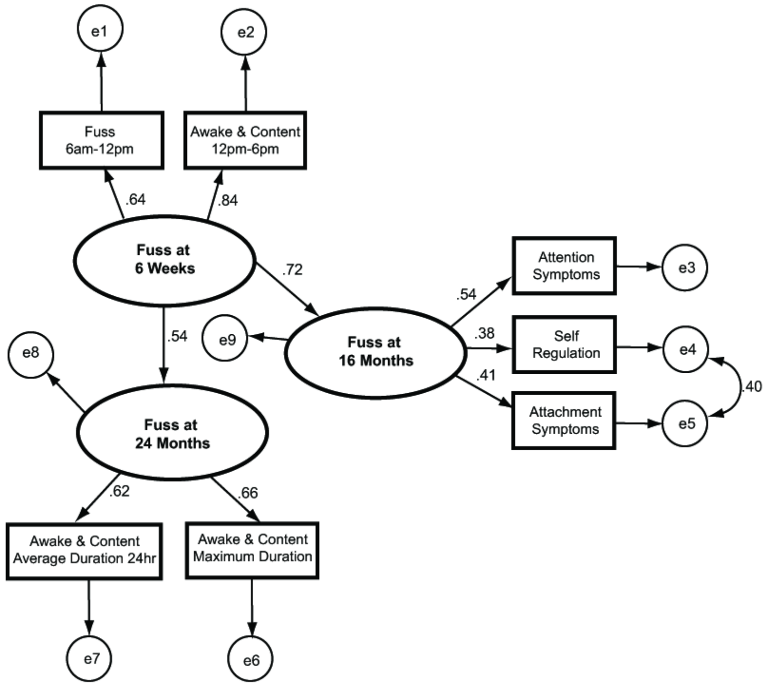
e1
e2
Fuss
6am-12pm
Awake & Content
12pm-6pm
.64
.84
Fuss at
6 Weeks
.72
Attention
Symptoms
e3
.54
.54
e9
Fuss at
16 Months
.38
Self
Regulation
e4
e8
.41
.40
Attachment
Symptoms
e5
Fuss at
24 Months
.62
.66
Awake & Content
Average Duration 24hr
Awake & Content
Maximum Duration
e7
e6

Figure 4.

Table 1

Mean Scores and Standard Deviations for Infant Characteristics Questionnaire (ICQ) Factors

N = 120	**Mother**		**Father**	
Variable	***M***	***SD***	***M***	***SD***
Difficult/Fussy	20.38	4.85	21.65	5.03
Unadaptable	9.80	4.07	10.75	4.02
Dullness	3.20	2.09	3.29	1.96
Unpredictable	10.54	2.90	10.50	2.71
Composite Score	3.37	0.62	3.43	0.61

Table 2

Structural Equation Variables and Definitions

Wakefulness Structural Equation Model	
Wakefulness at 6 Weeks	
Awake & Content 6 am- 12 pm	Average time across diary days spent awake & content during this period (minutes)
Awake & Content 12 pm- 6 pm	Average time across diary days spent awake & content during this period (minutes)
Awake & Content 6 pm- 12 am	Average time across diary days spent awake & content during this period (minutes)
Wakefulness at 24 Months	
Awake & Content Average Duration 24hr	Average duration awake & content across diary days (minutes)
Awake & Content Minimum Duration	Minimum length of time spent awake & content (minutes)
Awake & Content Maximum Duration	Maximum length of time spent awake & content (minutes)
Fuss Structural Equation Model	
Fuss at 6 Weeks	
Fuss 6 am- 12 pm	Average time across diary days spent in fuss state during this period (minutes)
Fuss 12 pm- 6pm	Average time across diary days spent in fuss state during this period (minutes)
Fuss at 16 Months	
Attention Symptoms	TSC Subscale: Measuring ability to pay attention
Self Regulation	TSC Subscale: Measuring ability to self sooth
Attachment Symptoms	TSC Subscale: Measuring attachment to parents
Fuss at 24 Months	
Fuss Maximum Duration	Maximum length of time spent in fuss (minutes)
Fuss Frequency 24hr	Average frequency of fuss states across diary days

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Table 3

Means, S.E. Means and Correlations Among Wakefulness Model Variables

	1	2	3	4	5	6
1. Awake & Content: 6AM-12PM	3.48					
2. Awake & Content: 12PM-6PM	.411	4.33				
3. Awake & Content: 6PM-12AM	.203	.144	4.21			
4. Awake & Content: Total Duration 24hr	.183	.370	.119	9.88		
5. Awake & Content: Minimum Duration	.045	.108	.060	.270	4.33	
6. Awake & Content: Maximum Duration	.086	.358	.095	.623	.445	7.18
Mean	91.34	114.47	96.05	540.57	38.61	197.90

Note: S.E. Means are on diagonal; correlations are below the diagonal. Correlations greater than .202 are significant

Table 4

Means, S.E. Means and Correlations Among Fuss Model Variables

	1	2	3	4	5	6	7
1. Fuss: 6AM-12PM	1.66						
2. Fuss: 12PM-6PM	.533	1.75					
3. Self Regulation	.233	.280	.194				
4. Attention Symptoms	.211	.362	.156	.114			
5. Attachment Symptoms	.193	.248	.491	.264	.204		
6. Fuss Frequency 24hr	.344	.340	−.033	.117	−.110	.199	
7. Fuss Maximum Duration	.271	.267	.083	.201	.068	.416	1.78
Mean	20.66	27.32	2.26	.63	2.07	2.08	20.30

Note: S.E. Means are on diagonal; correlations are below the diagonal. Correlations greater than .192 are significant