

Infant temperament moderates associations between childcare type and quantity and externalizing and internalizing behaviors at 2 ½ years

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Abstract:

This study tested interactive effects of quantity and type (center-based versus other) of non-parental care, and infant temperament, on children's externalizing and internalizing behaviors at 2 ½, controlling for childcare quality. Sixty-four mothers and children participated. Mothers rated depressive symptoms prenatally, infant temperament at 5 months, childcare quality and child behavior at 2 ½ years, and reported childcare arrangements. At 6 months, infants were videotaped to obtain a measure of activity in response to novelty. Based on ANCOVA, *long hours in non-parental care* were associated with: (1) more externalizing for children in center care identified as easily frustrated as infants; and (2) more internalizing for children identified as both highly distressed and highly active in response to novelty as infants. Children in higher quality childcare were less externalizing and internalizing than those in lower quality childcare; this effect remained significant with all other variables controlled.

Keywords: Childcare quantity | Center-based childcare | Infant temperament | Externalizing/internalizing

Article:

1. Introduction

Based on cumulative research findings, it is evident that the *quality* of non-maternal care infants and young children experience contributes significantly to the impact of childcare on children's development. Researchers have reported significant effects of childcare quality on children, with higher quality childcare predicting better outcomes fairly consistently (Love et al., 2003, NICHD, 1998, NICHD, 2003), especially for children from low-income families. Quality effects are larger also when children attending poor quality childcare settings are included in the sample (e.g., Sagi, Koren-Karie, Gini, Ziv, & Joels, 2002). These data are important, but do not tell the whole story about childcare effects on children, as Belsky (2001) notes in his historical review of

the childcare debate and evidence. The possibility that long hours in day care adversely affect children's development has been a central issue in that debate for nearly two decades, and new data have renewed interest in the impact of quantity of childcare effects.

Long hours in childcare, and more center-based care were associated with aggressive behavior during early childhood (NICHD, 2003), and morning to afternoon increases in cortisol (a measure of stress reactivity) have been reported for infants and toddlers in full-day, center-based childcare (Watamura, Donzella, Alwin, & Gunnar, 2003), controlling for childcare quality. Others have reported associations between temperament, cortisol increases in center-based childcare, and both internalizing and externalizing behaviors (Kipp, 1995; Tout, de Haan, Kipp-Campbell, & Gunnar, 1998), suggesting that long hours in *center-based* care contribute to young children's behavioral tendencies, perhaps in conjunction with temperamental differences (Crockenberg, 2003). We test these hypotheses in this study, in an effort to identify conditions under which 2-year-olds in childcare are more or less likely to develop these behaviors.

1.1. Center-based childcare as a contributor to children's behavioral development

Often children in center-based care have poorer developmental outcomes than do children in other types of childcare (NICHD, 2003, Sagi et al., 2002), even with amount of time in care controlled, although this effect may be moderated by childcare quality, and influenced by the childcare contexts to which center care is compared. Nonetheless, other aspects of center-based childcare, such as type and range of activities, the choice to participate in activities, and group composition (Harper & Huie, 1998), distinguish center-based child care from both home and family day care, and could explain the increasing cortisol levels and behavior tendencies associated with long hours in center-based care. We develop this line of reasoning briefly below to provide a conceptual basis for expecting long hours in center-based childcare to affect children adversely.

Group social interaction may be stressful because it requires children to engage with others. From Watamura et al. (2003), we know that children who engage in less social interaction show greater cortisol increases during the day, and it may be that stress occurs because even that much interaction is too much for some children, or because non-interaction comes at a cost in a context where social interaction is considered adaptive. At home, children can and do play alone, sometimes retreating to their rooms to prevent interruption from siblings or parents, or spending one-on-one time with a parent. In family childcare, older children may nurture younger children, serving as "adult substitutes" when necessary, and protecting them from some of the stresses inherent in social interaction. Such opportunities are less frequent in childcare centers.

Fabes, Harnish, and Martin (2003) point out similarly that center-based childcare brings young children into greater and more regular contact with more same-age peers than is typical at home, in neighborhoods, or even in family day care, where typically group size is smaller, with same-sex peer groups having the strongest socializing influence. In particular, boys' peer groups involve physical contact, fighting, and taunting, as well as a hierarchical pecking order that increases certain kinds of conflicts and opportunities for boys to be winners or losers. This is significant in light of recent evidence that competition increases stress in young children. Donzella, Gunnar, Krueger, and Alwin (2000) reported decreasing vagal tone as

children began to play competitively, indicating increased stress, and further decreases for children who became tense or angry as they began to lose, reactions linked to rising cortisol levels during competition. At homes and in family day care, such events should be less frequent on average, because fewer same-age, same-sex children are present in those contexts.

1.2. Temperament as a moderator of children's reactions to childcare

Evidence that temperamental differences in infants and children moderate the impact of childcare on development is scant, but provocative. In a study by Dettling, Parker, Lane, Sebanc, and Gunnar (2000), increases in cortisol production from morning to afternoon in center-based childcare were greater for more emotionally negative children, and for those with lower self-control. Similarly, children rated as more negative by researchers on arrival at childcare centers, and more temperamentally active by teachers on a standard toddler temperament assessment, had higher cortisol responses 90 min later, and engaged in more negative behavior toward peers and adults during intervening observations (Kipp, 1995). Additionally, in Watamura et al. (2003), teacher-reported social fearfulness was associated with larger cortisol increases from morning to afternoon among children attending full-time, center-based childcare. These data are consistent with the view that temperamental characteristics predispose some children to greater stress responses in certain childcare contexts, but they are by no means conclusive. The link between social fear and increases in cortisol in full-time childcare may reflect the effect of those increases on children's withdrawal (and thus teacher-rated fearfulness), rather than the reverse.

It follows from the above that researchers need to both control for pre-existing characteristics of children, as well as for childcare quality, and test moderating effects of temperament in assessing effects of long hours in non-parental care, particularly center-based care, on children. Equally important is the choice of appropriate temperament assessments. Based on what we know about fear and anger being linked to different sides of the brain (e.g., Dawson, 1994), we would expect specific measures of infant negative reactivity (i.e., distress to novelty, distress to limits) to predict specific child behaviors (e.g., fearfulness, aggression) better than global measures of "difficulty."

1.3. Hypotheses

In sum, both argument and evidence suggest that long hours in center-care are more stressful for young children than long hours in other types of care, everything else equal, and that fearful or easily frustrated children may be most adversely affected by these conditions. Thus, we hypothesize that 2-year-olds who spend long hours in non-parental care engage in more externalizing and internalizing behaviors: (1) if they are in center-based rather than other types of non-parental care, or home care; (2) if they are more rather than less temperamentally reactive as infants; and (3) more so if these conditions (center care and temperamental reactivity) co-occur.

We hypothesize further that emotion-specific measures of infant temperament are linked with specific child behaviors. Distress to limits (frustration) is expected to predict externalizing behavior, whereas distress to novelty (fearfulness) is expected to predict internalizing behavior. Based on prior research on behavioral inhibition and anxiety (Crockenberg & Leerkes, 2003; Kagan, Snidman, Zentner, & Peterson, 1999), high infant distress to novelty coupled with

high activity in response to novelty is a likely antecedent of young children's internalizing, and we include it as the primary temperament predictor of internalizing for this reason.

2. Method

2.1. Participants

Sixty-four primiparous mothers and toddlers, of 92 on whom complete 6-month data were available, participated at 2 ½ years. Mothers averaged 31 years (range 21–41 years), had 16 years of education (range 11–20 years), and had been married/living with a partner for 5 years; 95% were Caucasian, 3% Asian, 2% Hispanic. Mean family income was \$61,460 (range \$15,000–140,000). Thirty-eight toddlers were male. All had been healthy at birth and full-term.

All mothers who remained in the area and who were willing to participate were included. Those who did not participate indicated that they were too busy for a variety of reasons, including the imminent or recent birth of another child. With one exception, participants did not differ from non-participants on demographic, maternal, or infant variables, or on childcare experience at 6 months, p levels $>.20$, two-tailed; mothers who participated at 2 ½ were more educated than those who did not, $t(90) = -2.12$, $p < .05$, $M_s = 15.6$ and 14.8 years, respectively.

2.2. Procedure

Two months prior to delivery, mothers were recruited from birthing classes, and completed a demographic questionnaire by phone and a depressive symptoms questionnaire by mail. At 5 months postpartum, mothers rated infant temperament by phone; at 6 months, infants were videotaped during an assessment of infant affect and regulation, and mothers reported their childcare arrangements. When children were 2 ½, mothers reported their current childcare arrangements, and rated childcare quality by phone, then rated children's behavior on questionnaires that were mailed to them. Mothers received \$10 and were entered into a \$100 lottery for wave 1 data collection, and \$20 for participating in the follow-up.

2.3. Measures

2.3.1. The Center for Epidemiologic Studies—Depression Scale (CES-D; Radloff, 1977)

Depressive symptoms were assessed using this 20-item checklist of moods, feelings, and cognitions associated with depression (e.g., I felt depressed, I felt that people dislike me) designed for use with community samples. Respondents indicate on a 4-point scale how often they felt or thought a particular way during the previous week. The CES-D has demonstrated good/adequate convergent validity with Research Diagnostic Criteria for depression, a standardized psychiatric interview, and with the Beck Depression Inventory (Spitzer, Endicott, & Robins, 1978). Items were averaged to derive a prenatal measure of depressive symptoms (Cronbach's $\alpha = .88$), included as a covariate when regressing internalizing on its predictors.

2.3.2. Infant Behavior Questionnaire (IBQ)

Two IBQ subscales (Rothbart, 1981) were administered to assess mothers' perceptions of their infant's temperament, distress to limitations (frustration), and distress and latency to approach sudden or novel stimuli (fear). Mothers indicated on a 7-point scale how frequently their infants responded to specific events in a particular fashion during the previous week (e.g., when introduced to a stranger, clung to the parent or approached the stranger at once). At 6 months, subscales have good internal reliability (.75–.81), inter-rater reliability (.54–.66), concurrent validity with home observations of infant temperament, mean $r = .40$, and with the negative emotionality and approach-sociability subscales of the Revised Infant Temperament Questionnaire and the Infant Characteristics Questionnaire, $r = .61–.73$ (Goldsmith, Rieser-Danner, & Briggs, 1991; Rothbart, 1981; Rothbart & Goldsmith, 1985). Mean ratings from the 17-item *distress to novelty* scale (Cronbach's $\alpha = .68$), and the 20-item *distress to limits* scale ($\alpha = .78$) served as emotion-specific measures of infant temperament.

2.3.3. Six-month behavioral observation

Infant behavior was videotaped during a laboratory assessment of infant emotion and emotion regulation, in which infants were placed in a car seat, situated so that by turning they could see their mothers, seated 3 ft away. The novel toys (a bumble ball and fire truck) were counterbalanced to control for order effects. During the first novelty task, mothers remained neutral so that we could observe infants' responses to the toy, both reactive and regulatory, without maternal intervention. Details of the assessment have been published elsewhere, and are available from the authors.¹

Infant behavior was coded *continuously* from videotapes using a computerized, event-based coding system. Trained students coded in pairs to maintain accuracy, while watching the videotape, operating the VCR, and entering codes; they were blind to other data. The authors coded 25 videotapes independently, at the beginning and midway through, to assess reliability and to prevent coder drift. Thirteen mutually exclusive behavioral codes, adapted from Rothbart, Ziaie, and O'Boyle (1992), were used to code infant behavior. Inter-coder reliability for all codes within a 1-s interval ranged from .65 to .87, mean $\kappa = .75$. Full descriptions of codes are available from the authors. Of these, only infant *activity* was included here based on its a priori association, in conjunction with distress to novelty, with internalizing-type behaviors, as explained above. *Activity* included stimulation and partial reach because both involved active movement and correlated similarly with other infant behaviors, as well as with each other, $r(87) = .43$; $p < .01$; the frequency distribution was positively skewed, and thus adjusted using a logarithmic transformation. For clarity, descriptive data are presented for the non-transformed variable, *mean* percent time in seconds = 6.28, range 0–33.24.

2.3.4. Child Behavior Checklist (CBCL)/2–3 (Achenbach, 1992)

This 100-item checklist was administered to mothers to assess children's behavioral tendencies. Mothers rate how true each item is for their child within the 2 months on a 3-point Likert scale (0, Not True; 1, Somewhat/Sometimes True; 2, Very/Often True). The CBCL/2–3 yields two broadband scales employed as measures of child behavior at 2 ½: externalizing, which includes aggressive and destructive scales; and internalizing, which includes anxious/depressed, withdrawn, and somatic symptoms scales. Both scales have high test–retest reliabilities, $r = .84$,

.87 over a 1-week period; good inter-parental agreement at age 2, $r = .69$ and $.67$; and stability over 1 year, $r = .67$ and $.65$, for externalizing and internalizing, respectively. Validity is supported by their ability to discriminate demographically matched, referred and non-referred children, with externalizing accounting for more variance than internalizing in discriminating boys, and the pattern reversed for girls (Achenbach, 1992).

Means (and standard deviations) for standardized t -scores were 49.05 (8.12) and 46.48 (8.59), for externalizing and internalizing scales, respectively. Externalizing and internalizing were normally distributed, and there were no outliers.

2.3.5. Childcare information

Mothers provided information when children were 6 months and 2 ½ years on their employment, type and quantity (hours per week) of childcare, and the age at which non-parental care began. At 2 ½ years, mothers rated their satisfaction with the *quality* of their current childcare on a 1–10 scale, with 1 indicating “very dissatisfied” and 10 “very satisfied”. This rating served as the measure of childcare quality. Although it lacks the specificity (i.e., regarding facilities and interactions) that characterizes standard measures of quality, this mother-report measure did *not* correlate significantly with maternal characteristics (i.e., maternal education, depressive symptoms), and therefore did not appear biased (see Table 2). Further support for its construct validity is inferred from its correlations with outcome measures, as discussed below. Children cared for by parents at home ($n = 25$), for whom no quality ratings were available, were given the mean childcare quality rating in order to include them in analyses.

Of the 31 infants in non-parental care at 6 months, only 8 were in center care, which precluded testing the interactive effect of long hours in center-based childcare at that age on later behavior, or its cumulative effect over time. Nor did age of entry into care, non-parental care at 6 months, or its quantity, correlate significantly with any 2 ½-year behavior, p values $>.20$. However, both age of entry and care quantity at 6 months correlated significantly with care quantity at 2 ½ years, $r(38) = -.56, p < .01$, and $r(38) = .56, p < .01$. Infants who entered non-parental care earlier, or spent longer hours in childcare at 6 months, spent more time in childcare at 2 ½ years, suggesting that any interactive effects of later quantity of care on child behavior might reflect the cumulative impact of long hours of childcare over time. To explore this possibility, we conducted post-hoc analyses in which any interaction significant with quantity of care at 2 ½ was replaced by the 6-month quantity variable.

Table 1. Descriptive data for children in non-parental childcare at 2 ½ years ($n = 39$)

	Center care ($n = 18$)			Other non-parental care ($n = 21$)		
	<i>M</i>	S.D.	Range	<i>M</i>	S.D.	Range
Quantity (hours per week)	29.9	12.1	6–45	30.5	14.1	8–50
Quality	8.1	1.9	4–10	8.9	1.4	5–10
Age of entry (in months)	8.9	8.8	1.5–30	6.5	5.7	2–24

Of the 40 children whose mothers were employed at 2 ½, 39 experienced some type of non-parental care. Of these, 18 were in center-based care, 21 were in family day care, or some other type of non-maternal care; one child was cared for exclusively by father in mother's absence, and

for analyses was included with the 24 children cared for at home by mothers. Descriptive data on the 2 ½-year childcare sample are presented in Table 1.

Table 2. Correlations between childcare variables, infant and mother predictors, and 2 ½-year behaviors

	2	3	4	5	6	7	8	9	10	11
1. IBQ distress to limits	.14	.09	-.02	-.00	.20	-.27*	-.21 ^t	-.03	.28*	.14
2. IBQ distress to novelty	—	-.15	.05	-.11	.17	.12	.07	-.04	.03	.02
3. Infant activity			-.02	.10	-.01	-.13	.23 ^t	.14	-.03	.10
4. Family income			—	.07	-.30*	-.04	-.03	-.08	-.04	-.11
5. Mother's education				—	-.26*	-.05	-.00	.08	-.21 ^t	-.19
6. Prenatal depression					—	-.03	.06	-.10	.16	.22 ^t
7. Reported childcare quality						—	.02	-.23 ^t	-.36**	-.26*
8. Childcare quantity							—	.39**	-.05	-.19
9. Childcare type								—	-.04	-.18
10. Externalizing behavior									—	.68**
11. Internalizing behavior										—

Note: $n = 64$.

^t $p < .10$, based on two-tailed tests.

* $p < .05$, based on two-tailed tests.

** $p < .01$, based on two-tailed tests.

3. Results

3.1. Zero-order correlations and child gender *t*-tests

Independent samples *t*-tests were used to test gender differences in predictors and outcomes. Only IBQ distress to limits (frustration) differed by gender; mothers rated males as more easily frustrated at 5 months ($M = 3.08$, S.D. = .62) than females ($M = 2.72$, S.D. = .66), $t(62) = 2.27$, $p < .05$. Thus, both gender and frustration were included in models testing conditions associated with differences in externalizing behavior, the presumed correlate of frustration.

Simple correlations were calculated between demographic, maternal, and infant variables, childcare predictors, and internalizing and externalizing behaviors to identify potential covariates and assess collinearity among predictors. As shown in Table 2, reported childcare quality correlated significantly and negatively with both child behaviors at 2 ½, but *not* with maternal education or depression, indicating that quality ratings were not biased by these maternal characteristics. Neither type nor quantity of care correlated with either child behavior. Reported care quality correlated negatively also with 5-month distress to limits, and both correlated in turn with externalizing behavior, possibly due to shared source variance. Maternal education correlated negatively with externalizing, depressive symptoms correlated positively with internalizing, as trends, and hence were covaried in subsequent analyses. Significant correlations remained when recalculated for children in non-parental care ($n = 39$), with one exception: the correlation of maternal education and depression was no longer significant, $r(38) = -.21$, $p > .10$. Distress to novelty correlated significantly with maternal depression also, $r(38) = .39$, $p < .05$.

Reported childcare quality correlated negatively, as a trend, with care type; mothers rated quality of center care lower than other types of care, although this association was only a one-tailed

trend for children in non-parental care, $r(38) = -.26, p < .06$. The correlation of care type and quantity was an artifact of including children in exclusive parent care in the other care group, as indicated by the low association for children in non-parental care, $r(38) = -.02$. As shown in Table 1, children averaged equal time in center-based and other types of non-parental care.

3.2. Interactive effects of childcare type, quantity, and infant characteristics on child behavior

ANCOVA were conducted on externalizing and internalizing behaviors to test the hypothesized interactions between childcare type, quantity, and temperament, controlling for reported childcare quality and other covariates specific to that behavioral outcome. In each analysis, care quantity, care type,² and infant temperament were included as fixed factors; care quality, and either maternal education and child gender, or maternal depression, were covariates. Interactions of care type and quantity, type and temperament, quantity and temperament, and the three-way interaction of type, quantity, and temperament were tested, the latter for externalizing only as explained below. Preliminary analyses were conducted to determine if child gender and care quality interacted with care type and quantity, and hence should be covaried in these analyses.

3.2.1. Preliminary analyses

To assess interactive effects of gender on child behavior, care type, care quantity, and child gender were included as fixed factors in the ANCOVA, and their interactions tested; care quality, and either maternal education or depression were covariates. There were no significant type by gender interactions, $F(1,54) = 2.71, p > .10$, and $F(1,54) = .10, ns$, for externalizing and internalizing behavior, respectively. Thus, child gender was included only as a covariate in the hypothesis testing analyses for externalizing, as explained above.

To determine if *quality* of childcare interacted with other childcare variables or infant temperament, care type, quantity, and quality, and temperament were included as fixed factors (based on median splits) in the ANCOVA, and their interactions tested, with child gender and either maternal education or depression covaried. There were no significant interactions between care quality and any other variable, for either child behavior, p values $> .20$; thus care quality was included as a simple covariate in the hypothesis testing analyses.

Table 3. Between subjects ANCOVA for externalizing behavior

Source	d.f.	SS	MS	F	p
Maternal education	1	151.12	151.12	3.16	<u>.08</u>
Reported childcare quality	1	385.18	385.18	8.06	.01
Child gender	1	.00	.00	.00	.99
Infant temperament (distress to limits)	1	39.97	39.97	.84	.37
Childcare type	1	.00	.00	.00	.99
Childcare quantity	1	.00	.00	.00	.99
Type × quantity	1	238.96	238.96	5.00	.03
Type × temperament	1	325.66	325.66	6.81	.01
Quantity × temperament	1	35.29	35.29	.74	.39
Type × quantity × temperament	1	134.88	134.88	2.82	<u>.09</u>
Error	51	2,438.80	47.82		
Total	64	158,107.00			

Note: Effects significant at $p < .05$ are boldfaced; trends, $p < .10$, are underlined.

3.2.2. Externalizing

As shown in Table 3, externalizing varied as a function of the covariates, maternal education (a trend) and reported care quality; lower education and lower quality were associated with more externalizing behavior. As hypothesized, care type interacted with care quantity, and separately with infant temperament, to predict externalizing; the three-way interaction of care type, quantity, and distress to limits was a trend.

To interpret the type by quantity interaction, ANCOVA were conducted within groups identified as high or low on quantity (i.e., hours of care per week). High hours was defined as more than 30 h a week of non-parental care, low hours as 30 or fewer hours a week, and included children in exclusive parental care. Care type and temperament were fixed factors, with care quality and child gender covaried. Childcare type was significant for children in non-parental care for long hours, $F(1,20) = 5.17, p < .05$. Children in long hours of center care were more externalizing than those in long hours of other non-parental care, $M = 50.73, S.E. = 1.97$, and $M = 44.00, S.E. = 2.01$, respectively. No effect of care type was seen for those in non-parental care for few or no hours, $F(1,42) = 2.69, p > .10, M = 45.11, S.E. = 2.84$, and $M = 50.57, S.E. = 1.39$, for center and other types of care, respectively.

To interpret the type by temperament interaction, type of care differences were tested within groups above or below the median of 5-month distress to limits to determine whether children identified as more or less easily frustrated as infants differed in externalizing as a function of the type of care experienced at 2 ½. Care type and quantity were fixed factors, with reported care quality and child gender covaried. When distress to limits was high (i.e., infants easily frustrated), externalizing differed by care type, $F(1,30) = 4.76, p < .05$. As expected, children who were easily frustrated as infants were more externalizing in center care than in other types of care, $M = 53.18, S.E. = 2.15$, and $M = 45.18, S.E. = 2.57$, for center and other care, respectively. Contrary to expectation, among children who were less easily frustrated as infants, those in other types of care were more externalizing than those in center-based childcare, $F(1,31) = 5.43, p < .05, M = 49.81, S.E. = 1.61$, and $M = 43.08, S.E. = 2.39$, for other and center care, respectively. However, when the analysis was repeated with children in non-parental care only, there was no longer a type of care effect in the low distress to limits group, $F(1,20) = .94, ns$, indicating that children in parental care explained the care type effect in the full sample, low distress group. Among children in non-parental care, differences in externalizing as a function of care type were apparent only for those identified as easily frustrated as infants, $F(1,17) = 5.70, p < .05, M = 53.54, S.E. = 1.57$, and $M = 47.94, S.E. = 1.52$.

Based on the hypotheses, long hours in center-based childcare were expected to be associated with externalizing behavior for children identified as temperamentally reactive (i.e., easily frustrated) as infants. Hence, testing the type \times quantity interaction within groups of more and less easily frustrated infants is justified, despite the trend shown by the three-way interaction in the full sample analysis (see Table 3). As expected, care type and quantity interacted to predict externalizing behavior among children easily frustrated as infants, $F(1,30) = 5.27, p < .05$, with reported care quality, maternal education, and child gender covaried. As shown in Fig. 1, among such children, externalizing behavior was higher for children in long hours of center care than for

children in long hours of other non-parental care. For children less easily frustrated as infants, there was no comparable interactive effect: $F(1,32) = .29$, ns.

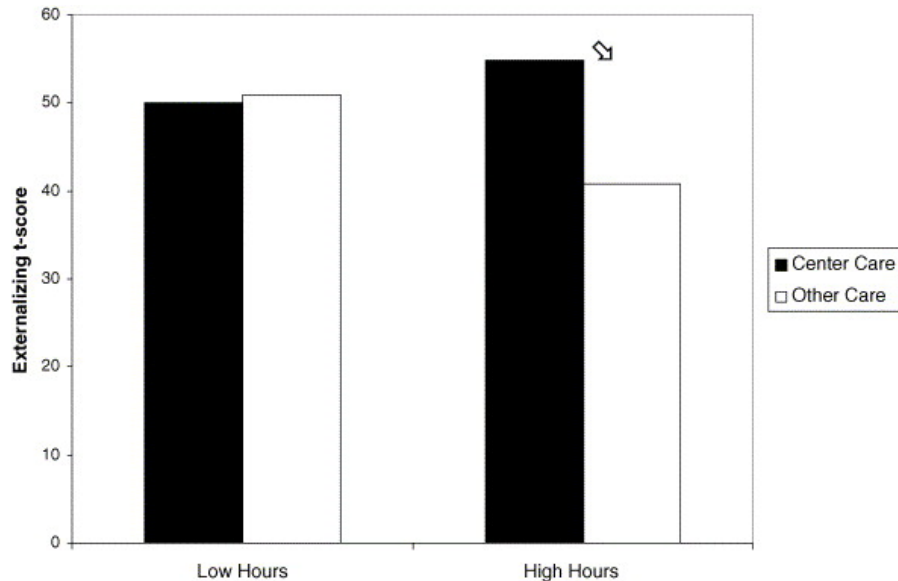


Fig. 1. Care type by quantity interaction in relation to externalizing behavior for children identified as highly distressed to limits (easily frustrated) as infants.

3.2.3. Internalizing

Including the distress to novelty by activity interaction as the temperament predictor of internalizing behavior creates the expectation of a four-way interaction (care type \times quantity \times distress to novelty \times activity), which could not be tested in this sample. Instead, two ANCOVA models were tested, one that included the three-way interaction of care type by distress to novelty by activity, and a second that included the three-way interaction of quantity by distress to novelty by activity. In the first analysis, the care type \times distress \times activity interaction was not significant, $F(1,63) = .07$, ns. Results of the second ANCOVA are shown in Table 4.

Table 4. Between subjects ANCOVA for internalizing behavior

Source	d.f.	SS	MS	<i>F</i>	<i>p</i>
Prenatal maternal depression		14.35		.27	.61
Reported childcare quality		491.91		9.08	.01
Infant temperament: distress to novelty		151.76		2.80	.10
Infant temperament: activity		96.83		1.79	.66
Childcare type		303.47		5.60	.02
Childcare quantity		28.27		.52	.47
Distress to novelty \times activity		363.40		6.70	.05
Type \times quantity		279.16		5.15	.03
Quantity \times distress to novelty		36.93		.68	.41
Quantity \times activity		10.23		.19	.66
Quantity \times activity \times distress to novelty		221.11		4.08	.05
Error	52	2,818.78	54.21		
Total	64	142,941.00			

Note: Effects significant at $p < .05$ are boldfaced.

Internalizing varied as a function of reported childcare quality and infant temperament, with higher quality associated with less, and a more reactive temperament (distress to novelty by activity) associated with more internalizing behavior. As hypothesized, care type interacted with care quantity to predict internalizing, and the three-way interaction of care quantity and temperament (quantity \times distress to novelty \times activity) was significant as well.

To interpret the *distress to novelty by activity interaction*, separate ANCOVA were conducted for groups above and below the median on infant activity, including infant temperament, care type, and care quantity as fixed factors, maternal depression and reported care quality as covariates. In the high activity group, there were mean differences in internalizing as a function of distress to novelty, $F(1,30) = 5.14, p < .05, M = 52.31, S.E. = 2.74$, and $M = 43.32, S.E. = 2.21$, for high and low distress to novelty, respectively. There was no comparable effect of distress to novelty in the low activity group, $F(1,32) = .04, ns$, and mean values of internalizing were low (relative to those of high distress, high active infants), $M = 42.21, S.E. = 2.09$, and $M = 42.93, S.E. = 3.04$, for high and low distress to novelty, respectively. Thus, children identified as infants as both highly distressed by and highly active in response to novelty were more internalizing at 2 ½ than other children.

To interpret the *care type by quantity interaction*, separate ANCOVA were conducted in groups high or low on quantity (i.e., hours of care per week). Care type and infant distress to novelty were fixed factors, with reported care quality, maternal depression, and infant activity covaried. Contrary to expectation, there was no effect of care type in the high hours group, $F(1,20) = .00, ns$, whereas in the low/no hours group, internalizing behavior differed as a function of care type, $F(1,42) = 13.32, p < .001$. Children in center care for 30 or fewer hours a week were *less* internalizing than those in other types of care (i.e., other non-parental for fewer hours, or parental care), $M = 37.91, S.E. = 2.77$, and $M = 49.54, S.E. = 1.31$, for center and other care, respectively.

To interpret the three-way interaction, and determine whether highly reactive (to novelty) infants who spent long hours in non-parental care were more internalizing than comparable children who spent few (or no) hours in non-parental childcare, separate ANCOVA were conducted for groups above and below the median of distress to novelty. Care quantity and type, and infant activity, were fixed factors, with reported care quality covaried. For children distressed by novelty as infants, quantity interacted with activity to predict internalizing, $F(1,31) = 9.35, p < .01$; there was no comparable effect for children less distressed as infants, $F(1,31) = .92, ns$. As shown in Fig. 2, children highly distressed and highly active in response to novelty as infants were more internalizing if they spent long hours, than if they spent few or no hours in non-parental care.

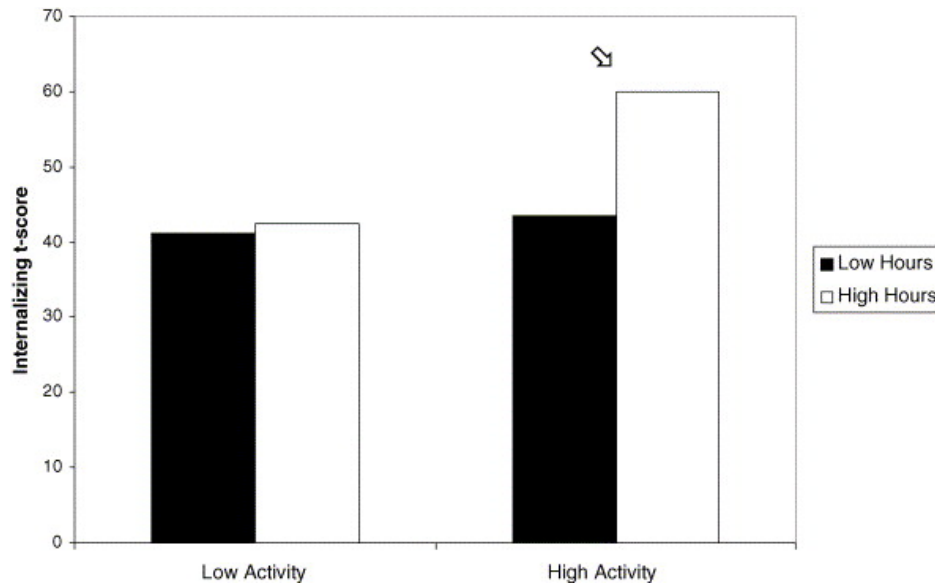


Fig. 2. Care quantity by activity interaction in relation to internalizing behavior for children identified as highly distressed by novelty as infants.

3.2.4. Post-hoc analyses

As a further test of possible cumulative effects of long hours in childcare over time on child behavior, we recalculated the ANCOVAs, substituting care quantity at 6 months for care quantity at 2 ½. We reasoned that if the three-way interactions that included care quantity remained significant with this substitution, it would suggest that early exposure to long hours of childcare might be affecting children's development, or contribute in a cumulative way to the effects of long hours in childcare observed at 2 ½ years.

There were no main effects of quantity of childcare at 6 months or two-way interactions in relation to internalizing at 2 ½ years, all p values $>.20$. However, care quantity at 6 months interacted with infant distress to novelty and activity in response to novelty to predict internalizing behavior at 2 ½ years, controlling for covariates, and main effects, and two-way interactions, $F(1,52) = 4.52, p < .05$. This replicated within the smaller childcare sample, $F(1,27) = 5.68, p < .05$, indicating that the effect was not a function of including children cared for exclusively by parents in the analyses. To interpret the interaction, ANCOVA were conducted within groups of infants cared for more and less than 30 h a week at 6 months. In the long hours group, distress to novelty and activity interacted to predict internalizing behavior at 2 ½, $F(1,24) = 8.33, p < .01$, whereas in the few or no hours group, the effect was not significant, $F(1,26) = .70$. Infants high in distress and activity to novelty in long hours of care at 6 months were more internalizing, $M = 57.15$ (S.E. = 3.13) than comparable infants in fewer hours of care, $M = 47.23$ (S.E. = 4.48). Infants low in distress and activity, and in few hours of care at 6 months, were least internalizing, $M = 34.14$ (S.E. = 5.86).

There was no comparable effect when the three-way interaction of quantity of care at 6 months was included with infant distress to novelty and care type at 2 ½ to predict externalizing behavior, controlling for covariates, main effects, and two-way interactions, $F(1,53) = .92, ns$. Nor was the

main effect of 6-month quantity of childcare, or any two-way interaction including that variable, significant in relation to externalizing behavior, all p values $>.20$.

4. Discussion

From these data, it appears that negative effects of long-hours in non-parental care depend on the context in which care occurs and the temperaments of the children involved. Additionally, emotion-specific patterns of infant temperament are linked with specific behavioral outcomes; distress to limits (ease of frustration) predicts externalizing, and distress to novelty (with activity) predicts internalizing, together with characteristics of non-parental childcare. The specificity of these effects suggests that global measures of temperament used in some other studies may have undermined efforts to detect interactive effects of temperament and childcare on children's behavior.

When easily frustrated infants spent long hours in center-based childcare at 2 ½, they engaged in more externalizing behavior than comparable infants who spent long hours in other types of non-parental childcare. No such effects were observed for children who were less easily frustrated as infants, identifying infant temperament as a moderator of the effects of subsequent childcare experience on child behavior. This fits what we know to date about the opportunities for frustration that center-based childcare tends to create by virtue of the competition and conflict that can arise in large groups of same-age children, and the rules governing the timing and changes in activities that often emerge in such contexts. It follows that children, who by temperament are easily frustrated by limits on their goal-directed behavior, will react more strongly to this set of conditions than less easily frustrated children, and because the effect of such experiences is cumulative, more so when they spend long hours in center-based care.

The finding reported above extends previous research on childcare in that neither the interactive effect of childcare type by quantity, nor its interaction with infant temperament, has been reported previously in relation to externalizing behavior. In the NICHD study (2003), having center care as a primary placement over a greater proportion of epochs predicted teacher-reported problems and conflicts in kindergarten, controlling care quantity, demonstrating only a main effect of center-based childcare. Absence of a main effect of quantity of childcare in this study, in contrast to the NICHD (2003) study, may reflect the fact that the majority of children in center care at 2 ½ were not in center care 2 years earlier, limiting any cumulative effect. Moreover, at 2 ½, children were younger than the NICHD children for whom main effects of care quantity were reported. The negative impact of long hours in center-care may increase when it occurs over several years.

A similar moderating effect of infant temperament occurred in relation to internalizing behavior. For children who were highly reactive to novelty as infants (more distressed *and* more active), those in more than 30 h of non-parental care a week at 2 ½ years were significantly more internalizing than comparable children in non-parental care for fewer hours or not at all. Less reactive children showed no elevated internalizing behavior when they spent long hours in non-parental childcare. Thus, the impact of long hours of non-parental care during the third year of life on concurrent internalizing behavior appears to depend on temperamental characteristics of children assessed 2 years earlier, before most had entered center care. However, the finding that

early temperament interacted also with long hours of non-parental care at 6 months introduces the possibility that long hours of childcare that begin early and continue contribute to the development of internalizing behavior in young children. There were too few children in this sample who were both highly reactive to novelty and who reduced the amount of time they spent in non-parental care over the 2 years to test this hypothesis (by comparing reactive children who continued in long hours of care with those who reduced the amount of non-parental care).

Additionally, type and quantity of care operated differently in relation to internalizing than externalizing behavior. Specifically, among children in few or no hours of non-parental care, those in center care exhibited the *least* internalizing behavior. This was unexpected in light of prior research in which cortisol increased during the day more in center care than in family day care (Dettling et al., 2000), but consistent with Gunnar, Tout, de Haan, Pierce, and Stansbury's (1997) report that in half-day nursery school, cortisol levels decreased from morning to afternoon, much as they did at home. We infer from this that the interaction of care type and quantity may reflect a beneficial effect of fewer hours in center-based childcare on children's internalizing, as much as a detrimental effect of long hours in center-based childcare, assuming comparable quality. For children predisposed to internalizing by virtue of their early reactivity to novelty, being in center care for shorter periods may provide opportunities for interaction that counteract their tendency to withdraw, and trained teachers may foster such interactions. Fox, Henderson, Rubin, Calkins, and Schmidt's (2001) finding that children identified as highly reactive to novelty at 4 months were less inhibited at age 2 if they had experienced non-parental care is consistent with this reasoning, although length of time in childcare was not considered in that study. Nevertheless, it is too soon to discount long hours in center care as a contributor to internalizing behavior for predisposed children because the small sample precluded testing the four-way interaction (care type \times quantity \times distress to novelty \times activity) that addresses this question.

That long hours in childcare (in conjunction with type of care and/or temperament) were associated with more externalizing and internalizing behaviors controlling for other variables increases confidence in the validity of the findings. Specifically, interactive effects were not attributable to maternal characteristics (i.e., education or depression), although pre-existing characteristics of mothers were associated with differences in children's externalizing and internalizing behaviors. Nor were they confounded by differences in care quality (as reported by mothers); interactive effects remained with reported quality controlled. Nevertheless, higher quality childcare was associated with less externalizing and internalizing, and remained significant after variance associated with other simple effects and interactions was accounted for, replicating previous findings. Thus, these data confirm the significance of high quality childcare for children's development, and, in so doing, support the construct validity of the maternal-report measure of childcare quality used in this study.

4.1. Conclusions, limitations, and future research

Taken together, the findings lend credibility to the inference that the effect of long hours in non-parental care on children's externalizing and internalizing behaviors depends on their temperamental characteristics identified during infancy, either before they began non-parental care, or shortly thereafter. They indicate also that, for externalizing, effects of long hours are

greater in center-based than in other non-parental childcare. Nonetheless, other variables not included in the study could explain the results, or variables that could not be adequately tested given the sample size might delimit further the conditions under which long hours in center care impact child behavior. It follows that research is needed in the following areas.

First, for reasons outlined above, the findings need to be replicated using a standard measure of childcare quality with a larger, more heterogeneous sample. The current sample consisted entirely of healthy, full-term infants, with relatively well-educated mothers, from Caucasian families with adequate incomes. For infants or families at greater biological or social/economic risk, effects of long hours in center care may be quite different (Love et al., 2003).

Second, measures of infant temperament, assessments of child behavior, as well as depressive symptoms and childcare quality, were based primarily on maternal reports, suggesting that source variance could explain some findings. This possibility is diminished, however, by the simultaneous inclusion of variables in the ANCOVA models, with the consequence that any shared variance, including source variance, is removed as a confounding factor. Nevertheless, replication of these findings using independent assessments of child behavior is needed.

Third, the cumulative impact of long hours of non-parental care that begin early and continue over time, on children predisposed to developing internalizing behavior by virtue of their early reactivity to novelty, remains to be tested.

Fourth, we need more fine-grained analyses of the conditions that exist in different types of non-parental care that contribute to differences in children's behavioral development. Although in this study we have considered possible detrimental effects of long hours in center-based childcare, on at least some children, the beneficial effects of center-based care on other children are well documented (e.g., Love et al., 2003). Thus, a useful next step in childcare research is identification of the contextual variables that explain why long hours in center-based childcare sometimes lead to increases in young children's externalizing and internalizing behaviors. In establishing the basis for the current study, we identified explanations of center care effects that could serve as the basis for future inquiries (e.g., that the demand for social interaction that tends to occur in large groups of children may increase stress levels for children who prefer less interaction, and for other children because of the increased potential for conflict that occurs as interactions multiply). The opportunity is ripe for collaboration between practitioners and researchers in an effort to identify and implement changes in childcare centers, and to evaluate their effects on children's and teachers' stress and behavior.

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Notes

¹ There were no moderating effects of infant behaviors in the frustration tasks on distress to limits (unpublished data), and hence no reason to include those tasks in this report.

² There were no mean differences in externalizing and internalizing behavior for children in exclusive parental care and those in other (non-center-based) non-parental care, controlling for other childcare variables and covariates, $M = 47.01$, $S.E. = 2.28$, and $M = 49.56$, $S.E. = 1.62$, respectively, for externalizing, and $M = 48.06$, $S.E. = 1.98$, and $M = 47.70$, $S.E. = 2.22$, respectively, for internalizing behavior. Therefore, to maintain statistical power, these groups were combined for most analyses comparing children in center-based childcare with other children.

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