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Testing a Series of Causal Propositions Relating Time in Child Care
to Children's Externalizing Behavior

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Abstract

Prior research has documented associations between child care hours and children's externalizing behavior. A series of longitudinal analyses were conducted to address five propositions, each testing the hypothesis that child care hours causes externalizing behavior. Data from the NICHD Study of Early Child Care and Youth Development were used in this investigation, because they include repeated measures of child care experiences, externalizing behavior, and family characteristics. There were three main findings. First, the evidence linking child care hours with externalizing behavior was equivocal in that results varied across model specifications. Second, the association between child care hours and externalizing behavior was not due to a child effect. Third, child care quality and proportion of time spent with a large group of peers moderated the effects of child care hours on externalizing behavior. Child care hours was more strongly related to externalizing behavior when children were in low-quality child care and when children spent a greater proportion of time with a large group of peers. The magnitude of associations between child care hours and externalizing behavior was modest. Implications for parents and policymakers must take into account that externalizing behavior is predicted from a constellation of variables in multiple contexts.

Testing a Series of Causal Propositions Relating Time in Child Care
to Children's Externalizing Behavior

Reviewers of the literature on early child care have frequently noted an association between spending more time in child care and exhibiting more externalizing behavior, such as assertive, disobedient, and aggressive acts (Belsky, 1986; 2001; Clarke-Stewart & Fein, 1983). Longitudinal investigations of externalizing problems indicate that these behaviors often persist into elementary school (Campbell, 1995, 2002; Campbell, Pierce, Moore, Marakovitz, & Newby, 1996; Verhulst & Van der Ende, 1992) and that elevated levels of externalizing problems are accompanied by peer rejection and poor academic performance (Campbell, 2002; Farmer & Bierman, 2002). Behavior problems can interfere with a child's acquisition of age-appropriate skills (Campbell, 2002), potentially leading to antisocial behavior in adolescence (Zahn-Waxler, Usher, Suomi, & Cole, 2005) and adulthood (Levenston, 2002). Even though child care experience has not been linked to clinical levels of problems, researchers and policymakers have worried that extensive use of child care in the early years might be a risk factor for increasing problem behaviors without causing clinical problems.

Studies have demonstrated that children exhibit more of these negative behaviors if they spend more time in care before they enter kindergarten (Bates, Marvinney, Kelly, Dodge, Bennett, & Pettit, 1994; Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Vandell & Corasaniti, 1990), are in more hours of care in the first year of life (Hofferth, 1999), start care at younger ages, or spend more hours there each day (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007). In the NICHD Study of Early Child Care and Youth Development (SECCYD), associations were documented between the amount of time children had spent in child care and externalizing behavior at 24 months of age (NICHD Early Child Care Research Network [ECCRN], 1998), at

54 months of age and in kindergarten (NICHD ECCRN, 2003); associations were maintained in models with controls for family background and child care experience, including quality, type, and instability of care. Empirical investigations have not always revealed significant associations between time in child care and behavior problems (Anne & Segal, 2004; Bacharach & Baumeister, 2003; Van Beijsterveldt, Hudziak, & Boomsma, 2005). Nevertheless, the finding has been replicated enough and is important enough to warrant further investigation.

The association between child care hours and externalizing behavior emerged more as an empirical finding than a theoretically anticipated one. Attachment theory was used to interpret the finding two decades ago based on the view that child-care induced insecurity could give rise to difficulties in emotion regulation and thus externalizing behaviors such as anger, aggression and disobedience (Belsky, 1986); however, when this proposition was directly tested there was no evidence to support it (NICHD ECCRN, 2003). Several researchers have also applied social learning theory to explain the child care hours finding. Belsky argued that extensive hours away from the child, especially beginning early in life, might make it more difficult for parents to get to know their children well and to interact harmoniously with them (Belsky, 1999, 2001; Patterson, 1986). As such, when the so-called “terrible twos” emerged, parents of children with extensive child-care histories might be less skilled in managing challenging behavior and thus inadvertently reinforce angry, negative behavior, thereby fostering externalizing behavior. Belsky and the NICHD Early Child Care Research Network found some support for this hypothesis. Specifically, extensive exposure to child care, especially beginning early in life, was predictive of less sensitive maternal behavior and less harmonious mother-child interactions across the first three years of life; however, direct tests of the mediating pathway from child care

through mother-child interaction to externalizing behavior failed to support this hypothesis (Belsky, 1999; NICHD ECCRN, 2003).

Using social learning theory, Clarke-Stewart (1989) argued that being exposed to both more pro- and anti-social behavior by peers in child care may explain why children in child care were more likely to display more of both types of behavior. Longer hours likely provided more opportunities to observe anti-social behavior among peers, especially when children were asked to conform to adult expectations regarding issues like sharing desired toys or objects. To our knowledge, this explanation has not been examined empirically.

The current study carefully examines the association between time in child care and externalizing behaviors during early childhood. We extend previous empirical research in two ways, by providing more specific measures of quantity of child care and by testing a series of propositions that provide the necessary, but not sufficient, conditions for demonstrating a causal association. Prior work has relied on aggregated indices of time spent in child care; this approach is unable to distinguish between consistent part-time care and entry into full time care half way through early childhood. In this study, we have separate measures of hours of care when in care and proportion of time in care. Furthermore, prior work has typically relied on cross-sectional analyses in which externalizing behavior at a given age is predicted from child care hours. In this study, we conduct longitudinal analyses so that we can identify when such associations emerge and whether they change over time. Collectively, this approach provides a more detailed representation of children's experiences than has been provided by previous research.

The second extension was to frame analyses in terms of "causal propositions." There is growing recognition among social scientists that analytic methods can provide evidence that is

consistent, or not, with causal explanations, even if they cannot establish causality per se (Duncan, Magnuson, & Ludwig, 2004). Here, we examine a series of propositions, which, if satisfied, would be consistent with the view that child care hours and externalizing behavior are causally linked. Data from the NICHD study are particularly valuable for this purpose because they come from a large, diverse, and stratified random sample, include measures of family and child characteristics, as well as types and quality of child care, and provide a longitudinal profile of changes in both child care and child outcomes.

Five Causal Propositions

Proposition 1. The association between externalizing behavior and time spent in child care will be significant even when selection factors are controlled.

A central issue in child care research concerns the fact that parents select child care arrangements nonrandomly. Our first proposition attempts to eliminate the possibility that the association between child care hours and externalizing behavior is actually attributable to characteristics of children and families who use care for different amounts of time rather than a direct consequence of the time the child spends in care. The choices families make in selecting and using care have been found to be related to beliefs about child care (Singer, Fuller, Kieley, & Wolf, 1998), attitudes toward child rearing (Bolger & Scarr, 1995; Vandell & Corasaniti, 1990), and income (Fuller, Holloway, & Liang, 1995). In the NICHD SECCYD, mothers with higher incomes placed their infants in child care at earlier ages, single mothers placed their children in child care homes and centers for more hours (NICHD ECCRN, 1998; 2003), and mothers who were less sensitive with their infants used more nonmaternal child care (NICHD ECCRN, 1999). Some of these parental characteristics are also related to children's externalizing behavior. Externalizing behavior is more frequent if mothers are insensitive (McCartney, Owen, Booth,

Clarke-Stewart, & Vandell, 2004; NICHD ECCRN, 1998; 2002) and if they are single or divorced (Deater-Deckard, Dunn, & Lussier, 2002; Emery, Waldron, Kitzmann, & Aaron, 1999; Harland, Reijneveld, Brugman, Verloove-Vanhorick, & Verhulst, 2002). Although unobserved selection factors (e.g., parents' motivation to spend less time with more difficult children) are not accounted for, analyses that take into consideration a wide range of child and family factors get closer to accurate estimates of the effects of child care on children's behavior than analyses that ignore these factors. Thus, in our first proposition, we reasoned that if spending more time in child care causes children to exhibit more externalizing behavior, the association should withstand stringent controls for all measured child and family selection factors (child gender and race/ethnicity, maternal education, partner status, parenting quality, depressive symptoms, and income).

Researchers have argued that the effects of child care hours cannot be meaningfully examined without controlling for child care quality. Numerous studies have documented links between poor quality care and negative peer interactions (Clarke-Stewart, Gruber, & Fitzgerald, 1994; Howes, 1990; Howes, Smith, & Galinsky, 1995; Howes et al., 1996; NICHD ECCRN, 2001a) and externalizing behavior (Hausfather, Toharia, LaRoche, & Engelsmann, 1997; NICHD ECCRN, 1998; Votruba-Drzal, Coley, & Chase-Lansdale, 2004). Therefore, it is reasonable to expect that the quality of care would help account for the association between externalizing behavior and hours in child care. Specifically, low quality care could exacerbate the adverse effect of long hours in child care; good quality care could buffer the effect (Phillips, McCartney, Scarr, & Howes, 1987). Even though no such interaction was detected in an earlier analysis by the NICHD ECCRN (2003), the fact that time in care is operationalized differently in the present investigation justifies re-examination of this key issue.

Proposition 2. The association between time spent in child care during infancy and the early preschool years and children's externalizing behavior will be significant even when child care hours in the later preschool years is controlled.

If time in care is causally related to child outcomes, another logical argument is that externalizing behavior should be predicted by earlier care, even with contemporaneous care controlled, because a cause must temporally precede an effect. Controlling for concurrent time in care also reduces the possibility that the association between child care hours and externalizing behavior is caused by the child (because children with more behavior problems are left in child care for longer hours every day or for more days of the week, for example) rather than by child care. This is a difficult proposition to test in the real world because children who spend a lot of time in child care early on tend to do so at later ages as well (Love et al., 2003; NICHD ECCRN 2003). Nevertheless, if the association between the amount of time spent in care at time 1 and externalizing behavior at time 2 is still significant after the amount of time spent in care at time 2 is controlled, this would be consistent with the causal argument that child care hours is linked with externalizing behavior.

Proposition 3. The association between externalizing behavior and time spent in child care will be significant even when earlier externalizing behavior is taken into account.

The third proposition also speaks to the question of whether a child effect accounts for the association between child care hours and externalizing behavior. A causal role for child care hours would be more plausible if, over time, children who spent more time in care experienced greater *increases* in externalizing behavior than children who spent less time in care. We can examine this proposition by statistically controlling for children's externalizing behavior at earlier ages in a residualized change model (i.e., variance in an outcome at an earlier point in

time is controlled when predicting variance in an outcome at a later point in time) or by examining change in externalizing scores over time (see NICHD ECCRN & Duncan, 2003 for details regarding the two approaches). If child care hours exerts its influence on externalizing behavior very early on (leading to the significant association between child care hours and externalizing behavior that was observed at 24 months; NICHD ECCRN, 1998), then controlling for early externalizing behavior reduces our ability to detect an effect, and null findings must be evaluated with caution. However, in light of the stringency of the test, significant findings would provide strong support for a child care hours effect and virtually eliminate the possibility that associations between child care hours and externalizing behavior are caused by the child rather than by care.

Proposition 4. There will be a dose-response relation between externalizing behavior and time spent in child care.

If child care hours is causally related to children's externalizing behavior, then it is reasonable to expect a "dose-response" relation such that *more* hours in care results in *more* externalizing behavior. At one level, the association between hours in care and externalizing behavior is itself evidence of a dose-response relation. In this paper, however, we move beyond this association by examining the relation between *increases* in child care hours and *increases* in externalizing behavior. We can model this by assessing whether within-child changes in the number of hours in child care predicts externalizing behavior. Previously, the NICHD ECCRN (2003) assessed within-child changes by modeling child care hours slope from infancy through 54 months. Here, we model increases and decreases in hours over targeted intervals (1 to 24 months, 25 to 36 months, and 37 to 54 months). Importantly, in these analyses, we control for child care hours so that we can assess the effect of change in hours per se.

Proposition 5. The association between externalizing behavior and time spent in child care can be explained by specific child care processes.

Finally, to the extent that associations are found between externalizing behavior and a theoretically predicted process related to time in care, a causal effect of hours becomes more plausible. In this inquiry, therefore, we investigate the possibility that the process underlying the association between externalizing behavior and child care hours involves children spending many hours in environments in which children are abundant and adult attention is not. Building on research conducted by Fabes, Hanish, and Martin (2003), the NICHD ECCRN (2001a, 2003) and others, we explore a peer variable as a potential moderator of the child care hours effect. Specifically, we examine variation in children's exposure to peers under limited adult supervision in a care setting with a high child-adult ratio. We argue that children may learn externalizing behaviors when peers model those behaviors in child care and that spending long hours in care provides more opportunity for modeling. Further, we suspect that caregivers are better able to practice behavior management skills and to prevent, monitor, and correct externalizing behavior when caring for a small number of children. In settings with many children, children get less individual attention from adults (Blatchford, 2003), caregiving is less adequate, developmentally appropriate activities are less common (Howes, Phillips, & Whitebook, 1992), teachers are less sensitive and more reliant on negative discipline (Howes et al., 1996), less likely to intervene in peer interactions in ways that help children become autonomous in negotiating successful peer interaction (Kemple, David & Hysmith, 1998), and children wander aimlessly (Ruopp, Travers, Glantz, & Coelen, 1979; Vandell & Powers, 1983). Increased pressure for space and difficulty getting individual attention from the teacher in a setting with many children add to the likelihood of interaction with peers (Blatchford, 2003),

including conflict and aggression (Smith, McMillan, Kennedy, & Ratcliffe, 1989; Smith & Connolly, 1980). To support the final proposition, then, we look for evidence that the association between child care hours and externalizing behavior depends on being in care with a large group of peers.

Taking One Step Forward

To summarize, the present report extends previous reports from the NICHD SECCYD in a number of ways. It provides more differentiated estimates of the child care hours experienced by children, tests longitudinal models of both predictors and outcomes, and explores a variety of propositions that bear on the causal nature of the association between child care hours and externalizing behavior. These propositions are not all equal or independent. They must be considered together to draw a conclusion about the nature of the association between child care hours and externalizing behavior. Moreover, finding support for all of them would still not prove that child care hours causes externalizing behavior although it would greatly strengthen the argument. Failing to find support for the propositions also would not prove that child care hours does not affect child behavior, only that evidence of a causal link was not provided by this particular study (i.e., absence of evidence is not evidence of absence). At the very least, the extent to which the data support the five propositions would indicate the robustness of the association between child care hours and externalizing behavior and provide insight into the conditions under which the association is and is not found. Ideally, the results of our analyses would be used to guide further research and would be supplemented with causal analyses of experimental or quasi-experimental studies.

METHOD

Sample

Families participating in the NICHD SECCYD were initially contacted through hospital visits to mothers after the birth of a child in 1991. Families lived in or near Little Rock, AR; Irvine, CA; Lawrence KS; Boston, MA; Philadelphia, PA; Pittsburgh, PA; Charlottesville, VA; Morganton, NC; Seattle, WA; and Madison, WI. There were three phases of enrollment. First, of the 8,986 families that experienced a birth during the sampling period, 5,416 (60%) met the eligibility requirements (mother healthy, older than 18 years, and conversant in English; child healthy, singleton, and not adopted; family not planning to move, residing in a neighborhood that was not extremely unsafe, living within 1 hour of the research site, and not participating in another study). Of the mothers, 130 (1%) refused to be interviewed in the hospital and 308 (3%) declined to be contacted again. Second, 3,015 families (56% of those eligible) were invited to participate in the study. Mothers from the eligible pool were called according to a conditional random sampling plan that ensured that the recruited families reflected economic, educational, and ethnic diversity. Third, of the 3,015 families called, 1,526 (51%) agreed to participate. There were various reasons that families could not participate: 60 babies were in the hospital for a week or more; 91 families were planning to move; 512 families could not be contacted; 641 families declined; and 185 families had other reasons. Of the 1,526 families that agreed to participate, 1,364 (89%) completed the 1-month visit and were officially enrolled in the study.

Mothers in the sample had an average of 14.4 years of education and 83.5% were partnered; average family income was 3.6 times the poverty threshold, although approximately one quarter of the families were poor; 79% of the infants were white, non-Hispanic. Thus, the sample was somewhat above average on key demographic indicators. At recruitment, 24% of the NICHD SECCYD sample was below the poverty threshold and 13% of the sample was Black, non-Hispanic, figures quite similar to those in the United States, which are 23% and 14%,

respectively (NCES, *Children Born in 2001*, 2004, p. 9). Of the 1,364 families that began the study, 1,083 (79%) continued through the 54-month assessment. They differed from the 281 families who were lost to follow-up in the following ways: mothers had significantly more education ($M = 14.4$ years vs. 13.6 years); family incomes were higher (mean income-to-needs ratio of 3.6 vs. 3.2); there was more likely to be a husband or partner in the household (85% vs. 76%); and the children were less likely to be Black, non-Hispanic (11% vs. 19%).

Measures

Externalizing behavior. Caregivers' reports of children's externalizing behavior were collected for all children who were in child care for at least 10 hours per week at 24- and 36-months of age using the Child Behavior Checklist for Ages 2-3 (CBCL-2/3; Achenbach, 1991) and at 54-months of age using the Caregiver-Teacher Report Form for Ages 2-5 (TRF; Achenbach, 1991; $n=565$ at 24 months, 614 at 36 months, and 705 at 54 months). The caregiver with whom the child interacted the most served as the reporter. Note that the provider had to care for the child for at least 10 hours per week. This provider was then asked to rate how characteristic of the child each of 100 problem behaviors was over the last two months (0 = not true; 1 = sometimes true; 2 = very true). Ratings of aggressive, assertive, disruptive, and noncompliant behavior were summed to represent externalizing behavior, based on a factor analysis of the original standardization sample (Achenbach, 1992). Scores on this scale were then converted to standardized T-scores based on normative data for children of the same age. Research indicates that these instruments show good test-retest reliability and concurrent and predictive validity; they discriminate between clinically referred and non-referred children and predict problem scores over a three-year period (Achenbach, Edelbrock, & Howell, 1987). Test-retest reliability for caregiver ratings of externalizing behavior for the NICHD sample was high

at all three ages (range .73 to .95). Further, internal consistency was high (α across ages ranged from .95 to .96).

It is worth noting that we elected to use caregivers' ratings and not mothers' ratings to be consistent with other empirical work. Most of the literature has focused on caregiver ratings because their ratings reflect children's behaviors in child care and because their ratings reflect caregivers' knowledge of the range of child behaviors observed across children within a classroom. To further validate teacher ratings of children's externalizing behavior, we correlated these behaviors with observer ratings of the child's aggression or angry affect in the child care setting (1 to 7 scale) using the Observational Rating of the Caregiving Environment (described below): $r=.22, p<.001$. Nevertheless, the decision to focus on caregiver ratings can be viewed as a limitation of this study.

Family Variables

Maternal education. Mother's education was represented by number of years of education as reported at 1 month.

Partner status. Maternal reports of her partner status were collected at 1, 6, 15, 24, 36, and 54 months and were treated as a time-varying predictor in all analyses. Mothers were considered partnered if they reported having a husband or partner living in the household.

Income-to-needs ratio. The ratio of family income-to-needs at 6, 15, 24, 36, and 54 months was computed by dividing total family income by the poverty threshold for the appropriate family size and was treated as a time-varying predictor in all analyses (U.S. Bureau of the Census, 1999). In addition, a categorical variable representing poverty status was created at each assessment for families having an income-to-needs ratio less than two (i.e., poor and working poor).

Parenting quality. Parenting quality was assessed by a composite variable consisting of maternal behavior ratings and scores on the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984) and was treated as time-varying in all analyses. Maternal behavior ratings were based on videotaped mother-child play with toys. At 6, 15, and 24 months, the rating scales of maternal sensitivity, positive regard for the child, and intrusiveness (reflected) were summed to form a composite representing maternal sensitivity; at 36 and 54 months, the scales of supportive presence, respect for the child's autonomy, and hostility (reflected) formed the maternal sensitivity composite (for more information on the parenting quality measures see NICHD ECCRN, 1999; 2001b). The HOME was administered at 6, 15, 36, and 54 months (α s ranged from .78 to .87) and reflects stimulation and support available to the child in the family context. Scores from each age were standardized within the sample and the mean of the standardized scores was computed to represent parenting for that age. Missing HOME scores at 24 months were imputed by computing the mean of the adjacent ages and then combining that imputed value with maternal sensitivity to form the parenting variable for that age.

Maternal depressive symptoms. Maternal reports of their own depressive symptoms were assessed at 1, 6, 15, 24, 36, and 54 months with the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) and were treated as a time-varying predictor. Cronbach's α s were high at each assessment (range = .88 to .91), and depression scores were moderately correlated over time (range = .41 to .58). A single variable representing average depressive symptoms across the six assessments was also computed.

Child Variables

Demographic characteristics. During home interviews at one month, mothers reported

children's race and ethnicity (non-Hispanic African American, non-Hispanic European American, Hispanic, or other), as well as gender (1 = male).

Child care Variables

Time in care. Cumulative amount of time in non-maternal care through the first 54-months of age was determined from telephone interviews with mothers every 3 months for the first 3 years and every 4 months thereafter. Based on this information, four measures of time in care were computed. One was the average number of child care hours each week, *when the child was in care*, for each of three age periods (1-24 months, 25-36 months, and 37-54 months). The association between child care hours and externalizing scores in the present study ($r = .16, p < .001$) was as strong as that between the measure of average child care hours and externalizing scores in the earlier NICHD ECCRN study (2003; $r = .13, p < .001$), providing evidence for the validity of time in care. The second measure was the proportion of time within each time interval that the child was in care (i.e., the number of months per year). Proportion of time in care was computed using number of months per age period (e.g., 23 for the 1-24 month age period) in the denominator. This proportion measure was highly bimodal, with children tending to have been in care for either very few months or many months; therefore, a dichotomous variable was created to indicate whether or not the child had been in child care during at least two-thirds of the months during that age period, such that 1 equals many months in care.

The third and fourth measures reflected directional change in child care hours for an individual child over time. We determined how much more or less time children spent in child care based on the maternal reports by subtracting the hours per week reported in consecutive phone calls. All positive values reflected increases and were summed to create our index of increases in hours of care during the first 24 months, between 25 and 36 months, and between 37 and 54 months. All negative values were summed to create our index of decreases during those

same time periods. On average, children's hours in care increased during each of the three age periods: 1-24 months, $M = 22.6$ hours, $SD = 21.2$); 25-36 months, ($M = 15.4$ hours, $SD = 16.9$); and 37-54 months, $M = 19.3$ hours, $SD = 18.6$. They decreased, on average, between 1-24 months ($M = -18.6$ hours, $SD = 20.7$), 25-36 months ($M = -12.3$ hours, $SD = 15.7$), and 37-54 months ($M = -14.6$ hours, $SD = 15.6$).

Quality of care. Children were observed in their primary child care arrangements when they were 6-, 15-, 24-, 36-, and 54-months old, if they spent a minimum number of hours per week in the setting. Between 6 and 36 months, the minimum number of hours was defined as 10; at 54 months, the minimum number of hours was 8 for children in group care and 12 for children alone with a caregiver. Observations were conducted on two half-day visits scheduled within a 2-week interval at each age from 6 to 36 months and at one half-day visit at 54 months. During each visit, observers completed two 44-minute cycles of the Observational Record of the Caregiving Environment (ORCE), a measure developed for this study (NICHD ECCRN, 1996, 2000). Qualitative ratings made during these observations were composited to represent the quality of caregiving for the individual child. At 6, 15, and 24 months, this composite consisted of the mean of five 4-point subscales (caregiver's sensitivity to child's nondistress signals, stimulation of child's development, positive regard toward child, detachment [reflected], and flatness of affect [reflected]). Cronbach's alphas ranged from .87 to .89. At 36 months, these five scales plus two additional scales, "fosters child's exploration" and "intrusive," [reflected], were included in the composite ($\alpha = .83$). At 54 months, the composite was the mean of sensitivity, stimulation of cognitive development, intrusiveness [reflected], and detachment [reflected] ($\alpha = .72$). Reliability estimates were computed for both master-coded videotapes and live observations using Pearson correlations and the repeated measures ANOVA formulation. These

reliability estimates ranged from .86 to .99. Detailed information about the observational system, training, and reliability are available in NICHD Early Child Care Research Network (1996; 2001b) and at <http://public.rit.org/secc>.

Proportion of time in care with a large group of peers. We sought to define “large group of peers” as typically found in a range of child care settings, including home-based care, where one caregiver typically cares for a group of children. Because this variable is regulable, it has important policy implications. It seemed reasonable to define a large group of peers as greater than or equal to the upper bound of ratio guidelines, adjusted for age. The American Public Health Association and the American Academy of Pediatrics (2002) guidelines for caregiver-child ratio are as follows: 1:4 at 24 months, 1:7 at 36 months, and 1:8 at 54 months. Thus, we defined a large group of peers as 4 or more at 24 months, 7 or more at 36 months, and 8 or more at 54 months. A continuous variable representing the proportion of time with a large group of peers was computed for each age period, 1-24 months, 25-36 months, and 37-54 months.

Center care. A dichotomous measure indicating whether the child was attending a child care center at each of the major assessment points (24, 36, and 54 months) was used as a time-varying measure in all longitudinal analyses. Note that previous reports using this dataset have used a continuous variable representing the proportion of time in center care from 1 to 54 months. However, because most children had no center care prior to the 36-month assessment, longitudinal measures indicating the amount of time in center care in the first two years or the third year were highly skewed, and as such, we used this dichotomous indicator instead. Not surprisingly, children in center care were very likely to experience large groups of peers, but not all children in center care were in large groups and not all children in large groups were in center care. This was especially true when children were 54 months of age. The association between

center care and proportion of time with a large group was .60 at 24 months (see Table A1) .75 at 36 months (see Table A2), and .43 at 54 months (see Table A3).

Data Analysis Plan

To address the five propositions that, should they be substantiated, would support a causal argument that time in child care causes externalizing behavior, we fitted a series of statistical models. In the previous report of the association between time in care and externalizing behavior (NICHD ECCRN, 2003), the network used two indexes of time in care: intercept, representing the average number of hours per week in nonmaternal care, centered between 3 months and 54 months, and slope, representing the linear rate of change in hours. The purpose of the present study was to model the effects of time in care on externalizing behavior at three specific time points (24, 36, and 54 months). All analyses in this paper included a group of four time-in-child care variables: mean child care hours when in care, child care hours squared, proportion of time in care, and the interaction between child care hours when in care and proportion of time in care. Child care hours squared was included to assess possible curvilinear associations and the interaction of child care hours by proportion of time in care was included in an attempt to further disaggregate child care hours from chronicity of care. The general analytic strategy involved testing the fit of the block of time in care variables, and, if significant, examining the individual parameter estimates.

Both longitudinal and multiple regression analyses were conducted. Longitudinal analyses were conducted to examine the developmental trajectories of externalizing behavior for children as a function of time in care to address propositions 1, 4, and 5. Because too few children were observed in care at all three ages (24, 36, and 54 months) to permit a reliable estimate of intercept and slope, a mixed-model repeated-measures analysis of variance was used

to predict externalizing scores at 24-, 36-, and 54-months of age from two indexes of time in care (child care hours and proportion of time in care). Multiple regression analyses were conducted to address propositions 2 and 3 regarding the extent to which later outcomes varied as a function of earlier or later child care hours or externalizing behavior.

All analyses included a common set of covariates: nine dummy variables representing the 10 data collection sites, child characteristics (gender and ethnicity), family characteristics (maternal education, a dummy variable indicating whether mother had partner in household, income/needs ratio, a dummy variable indicating whether the family income was less than twice the poverty threshold, maternal depression, and a parenting composite), and child care characteristics (the observed quality and whether the setting was a center). Many of the family and child care characteristics were measured longitudinally (i.e., partner status, income/needs ratio, poverty status, maternal depression, parenting, and child care quality) and were treated as time-varying covariates in the longitudinal analyses. Specific methods for each of the analyses are detailed below.

RESULTS

Descriptive Statistics

Means and standard deviations for the variables are presented in Table 1. Externalizing scores as rated by caregivers were comparable at all three ages in this sample to those for the normed sample reported by Achenbach (1991; $M = 50$ and $SD = 10$). There was moderate intra-individual stability in externalizing scores over time (see Table 2). On average, children spent 33.8 ($SD = 11.9$) hours per week in nonmaternal child care when they were in care across the first 54 months of life; 10% were in care for 8 or fewer hours per week, 15% for 9-20 hours, 25% for 21-34 hours, 25% for 35-42 hours, 15% for 43-50 hours, and 10% for 51-59 hours. The average

number of hours children spent in care was relatively stable across children from 24 to 54 months, ranging from 31.1 to 34.7 hours per week (see Table 1). There was great variability in child care hours across the 54-month period; for example, children in the bottom tenth percentile spent 15 hours or less in care, while children in the top tenth percentile spent 47 hours or more in care. The vast majority of children were in non-maternal care for most epochs; that is, they experienced regular child care from 1 month to 54 months. Within individual, there was reasonable stability of care, both with respect to hours and the proportion of time in care (see Table 2); nevertheless, there were substantial increases and decreases in the amount of time individual children spent in care across the three time intervals (see Table 1). Children were increasingly likely to be in center care as they got older; by 54 months of age 84% of children attended some form of center care. The majority of these center settings contained “large groups” of children, according to our operational definition.

Tests of Propositions

Proposition 1. The association between time spent in child care and children’s externalizing behavior will be significant even when selection factors are controlled.

To test Proposition 1, we first identified child and family variables from existing literature and past research that were selection factors with respect to time in care and/or correlates of externalizing behavior. Table 3 presents zero-order correlations between child care hours and externalizing behavior with variables reflecting family and child characteristics as well as other indexes of time in care. Children spent more hours in care during at least one of the three early childhood periods if their mothers had less education, had no partner, offered poorer quality parenting, had more depressive symptoms, or were poor. These same variables were also related to children’s externalizing scores. Specifically, children were rated by their child care providers

as showing more externalizing behaviors when mothers had less education, were single, reported more depressive symptoms, were poor, and were rated as providing lower quality parenting. Externalizing behavior was negatively related to child care quality as has been reported by others. Externalizing behavior was also negative related to center care, which appears counter-intuitive based on other studies that measure amount of time in center care. The negative association reported here, where center care is assessed at a given time point, likely reflects different expectations in behavior between center care teachers, who are typically better educated, and providers in other settings (NICHD ECCRN, 2000). Note also that boys had higher externalizing scores. Intercorrelations among all variables in the model are presented separately by age in Tables A1, A2, and A3.

Repeated measures analyses were conducted using a general linear mixed model approach (Singer & Willett, 2003). The outcome variable was externalizing behavior rated by child care providers. In general, in studies of development, most repeated assessments of individuals are correlated, because skill levels and behavioral characteristics at one age are correlated with skill levels and behavioral characteristics at other ages. In the present study, these dependencies in the data were accounted for by estimating a separate variance for each time point and a separate correlation among the three repeated measures. The primary predictors of interest were time-varying measures of the child's exact age at each assessment, mean child care hours when in care, proportion of time in care (dichotomized due to extreme skew), the interaction between child care hours and proportion of time in care, and the interactions between age and other variables in the model. The age by predictor interactions were included to provide estimates of age-specific effects and all continuous predictors were mean-centered to enhance interpretation of the main effect parameters. Finally, we computed interactions to examine

whether child gender, poverty, parenting quality, or child care quality moderated the associations between time in care and externalizing behavior. Effect sizes were computed as the unstandardized coefficient multiplied by the standard deviation for the predictor, divided by the standard deviation for the outcome; this reflects the amount of standardized change in the outcome variable associated with a one standard deviation change in the predictor.

As model 1 in Table 4 shows, even with the child and family covariates and center care and child care quality controlled, the block of variables representing time in care was significantly related to externalizing scores, $F(5,924) = 6.43, p < .001$. Specifically, child care hours was associated with higher externalizing scores, $F(1,924) = 20.33, p < .001$, and the magnitude of this association changed over time, $F(2,924) = 4.89, p < .01$. On average, child care hours was a stronger predictor of externalizing behavior at 24 ($d = .19$) and 54 ($d = .20$) months than at 36 months ($d = .02$). This pattern was also revealed in the significant quadratic association between child care hours and externalizing scores, $F(1,924) = 4.21, p < .05$. To examine the shape of the quadratic association, we estimated and graphed externalizing scores for children with 10, 20, 30, 40, and 50 hours of child care per week at 24, 36, and 54 months of age (see Figure 1). This figure illustrates that the association between child care hours and externalizing behavior was quadratic at 24 months (i.e., poorer outcomes were associated with both fewer and more child care hours), non-significant at 36 months, and linear at 54 months.

Gender, poverty and parenting did not moderate the associations between child care hours and externalizing behavior, but quality of care was a significant moderator, $F(1,924) = 4.10, p < .05$. The interaction between child care hours and child care quality is depicted in Figure 2. As can be seen, there is an effect of child care hours on externalizing behavior at all levels of quality. The association is multiplicative such that the child care hours effect is smallest in high-

quality care and largest in low-quality care. Effect sizes were computed to elucidate this interaction. Specifically, we computed an effect size for hours at one standard deviation above (labeled as high quality) and below (labeled as low quality) the mean for quality at each age: at 24 months high quality $d = .13$, low quality $d = .25$; at 36 months high quality $d = -.03$, low quality $d = .07$; and at 54 months, high quality $d = .16$, low quality $d = .23$. In sum, analyses to probe Proposition 1 indicated that spending more hours in care was related to higher externalizing scores at 24 and 54 months even when family and child selection variables, as well as other child care variables, were controlled. Importantly, the association between child care hours and externalizing behavior was moderated to some extent by the quality of care children experienced, such that hours of care when in care was a stronger predictor of externalizing behavior in lower-quality care than in higher quality care.

Child care in this study has been defined as any form of non-maternal care, including father care and grandparent care. We re-estimated the model using a sub-sample of the participants, excluding children in child care with fathers and grandparents. The pattern of significant effects was identical to those in Table 4, suggesting that the findings are robust. Results revealed, however, that child care hours with either father or grandparents was not significantly related to externalizing, $B = -.06$, $se = .04$, $p = .20$, and was a significantly weaker predictor than child care hours when in care with anyone other than mother, father, or grandparents, $B = .12$, $se = .03$, $p < .001$.

Proposition 2. The association between time spent in child care during infancy and the early preschool years and children's externalizing behavior will be significant even when child care hours in the later preschool years is controlled.

To test Proposition 2, a multiple regression analysis was conducted. Children's 54-month externalizing scores were regressed on linear and quadratic child care hours from 1 to 50 months, controlling for child care hours at 54 months as well as the set of child, family, and child care covariates (i.e., child gender and ethnicity, maternal education, presence of a partner in household, income-to-needs, poverty status, maternal depression, parenting quality, child care quality, whether the child was currently in a child care center, the interaction between quality and hours of child care, and site). For this analysis, all time-varying covariates were averaged across assessments to provide measures of their cumulative levels. Results indicated that earlier child care hours, defined as child care hours when in care, was a significant linear predictor of externalizing scores in this model, $B = .14$, $se = .04$; $F(1,654) = 12.01$, $p < .001$. In sum, these analyses provide evidence that earlier child care hours predicted externalizing scores, controlling for concurrent child care hours as well as selection factors.

A follow-up analysis was conducted to determine whether care in infancy was particularly important. We tested whether child care hours in the first two years predicted externalizing scores at 54 months with care in the third and fourth years controlled. Earlier child care hours did not significantly add to the prediction over later child care hours, $B = .02$, $se = .05$; $F(4,652) = .28$, $p = .60$. As such, the association does not appear to be due to hours during infancy *per se*. Note, however, that the association between hours in the first two years of life and hours in the later years is statistically significant (see Table 2); as such, this model is not as stringent as would be the case if early and later hours were truly independent. We also examined the possibility that hours of care during infancy or toddlerhood accounted for the association between preschool hours of care and teacher ratings of externalizing behavior. Results indicated

that child care hours in either the first two years or the third year did not eliminate the effect of preschool hours on externalizing scores at 54 months.

Proposition 3. The association between time spent in child care and children's externalizing behavior will be significant even when children's earlier externalizing behavior is taken into account.

If the association between child care hours and externalizing scores remains significant with earlier externalizing scores controlled, the likelihood of the association reflecting a child effect is further reduced. The first assessment of externalizing scores occurred at 24 months. For this reason, we assessed the impact of time in care from 24 to 54 months on externalizing scores at 54 months. Two different models were specified. First, we conducted an analysis of covariance in which we examined associations between 54-month externalizing scores and the two indexes of time in care (child care hours and proportion of time in care), controlling for 24-month externalizing scores as well as the set of child, family, and child care covariates from model 1. Results indicated that the block of measures of time in care predicted 54-month externalizing scores even with 24-month externalizing behavior was included a control variable, $F(3,336) = 3.26, p = .02$, and that child care hours accounted for this association, $B = .13, se = .06, p = .02$. In a parallel analysis, we controlled for 36-month externalizing scores as well as the set of child, family and child care covariates revealed that these measures of time in care from 36 to 54 months predicted 54-month externalizing scores even with 36-month externalizing behavior as a control variable, $F(3,384) = 4.06, p = .01$, and that child care hours accounted for this association, $B = .14, se = .04, p < .001$.

Second, we conducted a fixed-effects analysis. This provides a means to control for any unobserved subject-level heterogeneity (i.e., any unobserved third variable effect) that may bias

the association between a predictor and outcome variable, in this case child care hours and externalizing behavior. For this reason, fixed effects analysis provides a more conservative test than ordinary least-squares regression. The fixed-effects approach essentially fixes the influence of possible intervening third variables by analyzing change scores in the outcome, thereby providing the most powerful test of causality for non-experimental data when assumptions are met and when the measurement of the outcome variable has a similar reliability across time points, as is the case for externalizing behavior (Levy & Duncan, 2001). With two time points, a fixed-effects model is algebraically identical to a change model. It is more intuitively obvious how a fixed-effects analysis works with two time points than it is with three or more time points. Consider that when one creates a change score or difference score, one subtracts time-invariant endogenous variables that are associated with the predictor and outcome. Note that fixed-effects analysis is of limited use when the influence of third variables changes over time or when there is little change in the outcome over time (see McCartney, Bub, & Burchinal, 2006).

In this fixed-effects analysis, a multiple regression analysis was conducted in which changes in externalizing scores from 24 to 54 months were regressed on child care hours, controlling for the child, family, and child care covariates. Because we wanted to model changes in an outcome variable from 24 to 54 months, the indexes of time in care were recomputed to assess experience from 24 to 54 months only (rather than 1 to 54 months). Fixed-effects relies on change in the predictor and there was, in fact, evidence of change in child care hours between 24 and 54 months as demonstrated in Table 1. Results indicated that the block of time in care variables between 24 and 54 months was not associated with changes in externalizing scores between 24 and 54 months, $F(4,337) = .45, p = .77$. A parallel analysis looked at change from 36 to 54 months and did not find an association between time in care and externalizing behaviors,

$F(4,386) = 1.82, p = .14$. Although the block of time-in-care variables was not significant, hours in care between 36 and 54 months was significantly related to changes in externalizing scores between 36 and 54 months, $B = .11, se = .05, F(1,386) = 5.07, p = .02$, providing some evidence for a causal relation between hours in care and externalizing behavior.

Because the association between child care hours and externalizing behavior was present at 24 months, we re-fitted the fixed effects models with the 221 children who had less than 10 child care hours per week through 24 months and found that the results did not change (child care block $F(4,194) = .45, p = .77$; hours coefficient $B = .07, se = .11, p = .50$); there were not enough children ($n=30$) with fewer than 10 child care hours through 36 months to re-fit the 36-54 month fixed effects analysis. Taken together, the models testing proposition 3 provide mixed results concerning a causal relation between child care hours and externalizing behavior.

Proposition 4. There will be a dose-response relation between time spent in child care and children's externalizing behavior.

In a way, time in care is already a variable that indicates a “dose.” As such, the association between time in care and externalizing scores demonstrates a dose-response relation. Yet, this relation does not establish causality. For this reason, we conducted within-subject analyses in which *changes* in the number of hours children were in child care served as predictors of externalizing scores. Importantly, child care hours when in care was used as a control. The causal argument is that an increase in child care hours should lead to higher externalizing scores and a decrease in child care hours should lead to lower scores. Recall that increases and decreases in hours were constructed separately for each of the three time intervals (1-24 months, 25-36 months, and 37-54 months).

The repeated measures analysis of externalizing scores used the average number of hours

that child care increased and decreased as predictors in analyses that adjusted for site and selected child, family, and child care characteristics and the block of time in care variables. Average increases and average decreases in child care hours across time were each entered as time-varying predictors. Neither the main effects of the increases-in-hours variables, $B = -.03$, $se = .02$, $F(1,924) = 2.91$, $p = .09$, and the decreases-in-hours variables, $B = -.03$, $se = .02$, $F(1,924) = 3.21$, $p = .08$, nor the interactions with age [increases: $F(2,924) = .36$, $p = .70$; decreases: $F(2,924) = 0.42$, $p = .66$] were significantly related to externalizing scores. Average child care hours when in care remained a significant linear, $F(1,924) = 22.39$, $p < .001$, and quadratic $F(1,924) = 5.42$, $p = .02$, predictor in this model. In addition, the age-by-linear-hours interaction was also significant, $F(2,924) = 4.73$, $p = .01$. The association between increases in child care hours and externalizing scores was negative, though non-significant, and therefore in the “wrong” direction to demonstrate causality. Thus, the analyses of within-subject cross-time changes do not support a causal relation between child care hours and externalizing scores.

Proposition 5. The association between time spent in child care and children’s externalizing behavior can be explained by specific child care processes.

If there is a causal relation between child care hours and externalizing scores, then there should be a mechanism to explain it. In other words, it is important to explain how child care hours serves as a risk factor for young children’s development. Here we hypothesized that child care hours results in higher externalizing scores if children spend a greater proportion of time with a large group of peers. To test this, we added proportion of time with a large group of peers followed by an interaction between this variable and child care hours to Model 1 reported in Table 4. The main effect for proportion of time with a large group of peers ($F(1,924) = 7.01$, $p < .01$) and the interaction between child care hours and proportion of time with a large group of

peers ($F(2,924) = 5.73, p < .05$) was statistically significant. Children who spent a greater proportion of time with a large group of peers had higher externalizing scores than other children, and this difference was greater for children who experienced more child care hours (see Figure 3). Note that when this interaction term is added to model 1, the interaction between child care hours and child care quality becomes non-significant, suggesting shared variance between the two interactions.

We know from the zero-order correlations that proportion of time with a large group of peers was associated with center care. The question remains whether center care explains this interaction between child care hours and proportion of time with a large group of peers. We conducted two follow-up analyses. First, we added child care hours by center care to Model 2 in Table 4. All three interactions were non-significant, presumably due to shared methods variance. Second, we removed from the model proportion of time with a large group of peers as well as its interaction with child care hours; the remaining interactions were still not statistically significant. Thus, we conclude that center care does not explain completely the interaction between child care hours and proportion of time with a large group of peers.

DISCUSSION

An extensive literature on the effects of child care reveals both positive and negative associations with developmental outcomes (see Lamb & Ahnert, 2006). The purpose of the present study was to examine further a well-documented association between child care hours and externalizing behavior. We tested a series of propositions that, if supported, would be consistent with a casual explanation for the link between child care hours and externalizing behavior. Results supported the first proposition, specifically that on average children who spent more time in child care were rated by their caregivers as showing more externalizing behavior.

The association was statistically significant, albeit modest, after adjusting for mothers' education, partner status, parenting quality, depressive symptoms, poverty level, and child's gender and race/ethnicity. These findings, based on longitudinal models, replicate those from earlier cross-sectional analyses conducted by the NICHD ECCRN (2003). In both papers the association between child care hours and externalizing behavior was curvilinear, however, we cannot generate any reasonable explanation for why this association exists at 24 and 54 months but not at 36 months.

High-quality parenting was a negative predictor of externalizing behavior; neither parenting, nor poverty and gender moderated the effect of child care hours. Thus, the influence of child care hours and parenting is best described as additive. Even if parenting cannot completely compensate for an hours effect, its influence is still important. Other studies show that when parents are able to decrease the stress levels their children experience in child care settings through positive parent-child relations, children tend to exhibit fewer negative effects of child care (e.g., Ahnert, Gunnar, Lamb, & Barthel, 2004). Further, parents may balance the time they spend away from their children with time spent in playful activities during the morning and evening hours (e.g., Ahnert, Rickert, & Lamb, 2000).

Importantly, the effect of child care hours was moderated by child care quality, such that the child care hours effect was smaller under higher-quality conditions and larger under lower-quality quality conditions. This interaction suggests that child care quality protects children against some of the adverse effects of spending a lot of time in care. This is the first time that this interaction has emerged in analyses of NICHD SECCYD data, due perhaps to the new parameterization of time in child care. It will be important to document the robustness of this finding in future work. Nonetheless, this finding demonstrates that quality child care reduces the

association between child care hours and externalizing behavior even though it does not eliminate it. This study can be added to the many others documenting the importance of child care quality for children's development that collectively have led to a call to action to support policies promoting better early care and education (Phillips, McCartney & Sussman, 2006; Waldfogel, 2006).

Results also supported the second proposition, that child care hours is related to externalizing behavior after adjusting for child care hours in later years. A cause must precede an effect, so this demonstration is an important next step. Further, this finding suggests that the association between child care hours and externalizing behavior is not merely due to a child effect, such that children with more behavior problems are enrolled in care for more hours.

There was partial support for the third proposition, that child care hours is related to externalizing behavior, adjusting for earlier externalizing behavior. In the ANCOVA models, externalizing behavior at 54 months was significantly related to child care hours with externalizing behavior at 24 and 36 months controlled. In the fixed effects models support was mixed. More time in child care was not related to increased levels of externalizing behavior between 24 and 54 months; however, more time in child care was related to increased levels of externalizing behavior between 36 and 54 months.

There was no support for the fourth proposition that changes in child care hours would be related to changes in externalizing behavior between 24 and 54 months. Our natural experiment did not reveal an association between increases, or decreases, in child care hours and changes in externalizing behavior.

We found support for the fifth proposition, that the association between child care hours and children's externalizing behavior could be explained by specific child care processes.

Proportion of time spent with a large group of peers moderated the effect of child care hours on externalizing behavior. Specifically, long hours in care was more strongly related to externalizing behavior when children were in care with large groups of peers. Furthermore, at average or more hours of care, the association between child care hours and externalizing behavior was accounted for in part by being in a care setting with a large group of peers. Large group of peers are more likely in child care centers, making it somewhat difficult to distinguish the effects of large group care and center care per se. Nevertheless, we believe the interaction between child care hours and proportion of time with a large group of peers is an important contribution to the literature because it helps to explain the well-documented association between child care hours per se and externalizing behavior. Fabes et al. (2003) and Vandell, Nenide, and Van Winkle (2006) have suggested that peers are an important contributor to child care effects, a view consistent with these findings.

Child care quality also moderated the effect of child care hours on externalizing behavior, however it is apparent that these two interaction effects were not independent. The child care quality by hours interaction became nonsignificant, although not much smaller in magnitude, when the child care hours by proportion of time with a large group of peers interaction was entered into the model. This is not surprising, given that proportion of time spent with a large group of peers should be an indicator of child care quality. Collectively, these findings support efforts to regulate group size as a means to promote developmentally-appropriate practice among child care providers. Like all policy recommendations, this one must be considered in a larger social context. In this care, the cost of providing smaller group sizes must be weighed against the gains as well as competing demands for funds (McCartney, 2006).

Summary

There are three noteworthy findings from this investigation. The first is that results from the five propositions were equivocal, rendering it impossible to draw a definitive conclusion about the association between child care hours and externalizing behavior. We are impressed by the fixed effect findings from 36 to 54 months and by the consistent evidence of modest associations from the less stringent tests; however, we are concerned by the non-significance of the fixed effect test from 24 to 54 months and from the natural experiment that modeled the effect of increases and decreases in child care hours. Experimental or stringent quasi-experimental designs are needed to provide a more definitive test of any causal relation, including this provocative one. Although it may be difficult to randomly assign children to child care for varying hours, it should be possible to conduct experiments to shed light on this issue. For example, without interfering with parents' work schedules or raising ethical concerns, researchers could test the effect of hours with a large group of peers by providing randomly selected children in child care centers with an intervention, for example different amounts of time in a quiet place with few (or no) other children. Or researchers could evaluate training efforts with teachers focused on how to regulate negative peer interactions and promote children's social competence. Regression discontinuity designs might also be helpful in this context.

The second finding concerns omitted variables bias. This investigation contributes to the literature by demonstrating that the association between child care hours and externalizing behavior was not due to a child effect. Of course, it is possible in this non-experimental study that omitted variables, perhaps unmeasured child or family variables, could account for our

findings. No single method can address all sources of bias with complete assurance in non-experimental designs (McCartney et al., 2006). For this reason, we followed the advice of Winship and Morgan (1999) to assess how robust the association is to alternative methods. The approach practiced here, testing a series of causal hypotheses, will generate more convincing evidence than testing for a single significant association alone.

The third finding concerns two moderators of the association between child care hours and externalizing behavior: child care quality and proportion of time with a large group of peers. The identification of mechanisms is an important next step, because hours is a distal variable. This finding underscores an important point for developmentalists, parents, and policymakers alike – multiple forces influence children additively and interactively. These findings demonstrate clearly that externalizing behavior is predicted by a constellation of variables from multiple contexts. Newcombe (2003) essentially makes this point when she warns that potential risks of child care hours must be weighed against the benefits of maternal employment, including increased family income and decreased maternal depression, as well as the benefits of quality early childhood programs. It is worth highlighting both multiple forces and the size of effects when sharing developmental findings like these with the public.

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Table 1

Descriptive Statistics for All Variables

	Age of Assessment		
	24 months (<i>n</i> = 565) <i>M(SD)/%</i>	36 months (<i>n</i> = 614) <i>M(SD)/%</i>	54 months (<i>n</i> = 705) <i>M(SD)/%</i>
Externalizing <i>t</i> -scores	47.6 (9.7)	46.3 (10.2)	50.2 (9.6)
Time in Care			
Child care hours	31.1 (10.1)	36.7 (11.5)	34.7 (14.1)
In care 2/3 or more of time	73%	92%	94%
Prop time w/large group of peers	12.9 (15.0)	12.5 (15.6)	15.4 (13.6)
Increases in hours	22.6 (21.2)	15.4 (16.9)	19.3 (18.6)
Decreases in hours	-18.6 (20.7)	-12.3 (15.7)	-14.6 (15.6)
Child Characteristics			
Male	50%	50%	50%
Family Variables			
Maternal education	14.8 (2.4)	14.7 (2.5)	14.7 (2.5)
Partner in the household	86%	83%	86%
Parenting quality	.11 (.65)	.06 (.82)	.09 (.79)
Maternal depressive symptoms	1.8 (1.1)	1.8 (1.1)	1.9 (1.0)
Income-to-needs	4.1 (2.51)	3.9 (2.6)	3.9 (2.5)
Poverty (income-to-needs <2)	21%	28%	25%

Table 1 (cont.)

Descriptive Statistics for All Variables

	Age of Assessment		
	24 months (<i>n</i> = 565)	36 months (<i>n</i> = 614)	54 months (<i>n</i> = 705)
	<i>M(SD)/%</i>	<i>M(SD)/%</i>	<i>M(SD)/%</i>
<hr/>			
Child Care			
Center care	27%	42%	84%
Quality	2.9 (.41)	2.8 (.46)	3.0 (.55)
<hr/>			

Table 2

Stability of Externalizing Scores and Time in Care Over Time ($n = 965$)

	Age period		
	24 months	36 months	54 months
Externalizing scores			
24 months	--	.46 ^{***} ($n = 431$)	.28 ^{**} ($n = 374$)
36 months		--	.30 ^{***} ($n = 425$)
54 months			--
	1-24 months	25-36 months	37-54 months
Hours/week ($n = 1134$)			
1-24 months	--	.73 ^{***}	.53 ^{***}
25-36 months		--	.64 ^{***}
37-54 months			--
Prop time ($n = 1134$)			
1-24 months	--	.44 ^{***}	.16 ^{**}
25-36 months		--	.21 ^{**}
37-54 months			--

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3

Correlations between Predictor Variables and Child Care Hours and Externalizing Scores

	Child care hours			Externalizing scores		
	24 months (<i>n</i> = 565)	36 months (<i>n</i> = 614)	54 months (<i>n</i> = 705)	24 months (<i>n</i> = 565)	36 months (<i>n</i> = 614)	54 months (<i>n</i> = 705)
Time in Care						
Child Care Hours	--	--	--	.16***	.10*	.25***
Prop time in care	.38***	.08	.26***	-.05	.04	.02
Prop time w/large group	.30***	.28***	.37***	.09*	-.03	.16***
Child Characteristics						
Male	.01	.01	-.01	.07	.10*	-.03
Family Variables						
Maternal education	-.04	-.08	-.07*	-.18***	-.16***	-.19***
Partner in the household	-.07	-.12**	-.16***	-.05	-.10*	-.18***
Parenting quality	-.07	-.13**	-.11**	-.23***	-.26***	-.26***
Maternal depressive symptoms	.06	.05	.09*	.08	.11**	.14***
Income-to-needs	.10	.04	-.02	-.07	-.17***	-.11**
Poverty (income-to-needs < 2)	-.12**	-.03	.06	.12**	.17***	.20***

Table 3 (cont.)

Correlations between Predictor Variables and Child Care Hours and Externalizing Scores

	Child care hours			Externalizing scores		
	24 months (<i>n</i> = 565)	36 months (<i>n</i> = 614)	54 months (<i>n</i> = 705)	24 months (<i>n</i> = 565)	36 months (<i>n</i> = 614)	54 months (<i>n</i> = 705)
Child Care						
Center care	.07	.06	-.20***	-.04	-.10*	-.15***
Quality	-.12**	-.16***	-.19***	-.11*	-.12**	-.12**

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4
 Repeated Measures Analysis Relating Predictor Variables to Externalizing Behavior at 24, 36, and 54 months (*n*=941).

	Model 1					Model 2				
	Coefficients (se)			F statistic		Coefficients (se)			F statistic	
	24 m	36 m	54 m	Main Effect	Age Intrctn	24m	36m	54m	Main Effect	Age Intrctn
Age	48.67 ^a (.90)	45.48 ^b (.74)	50.06 ^a (.72)	10.85 ^{***}		48.70 ^a	45.44 ^b	50.34 ^a	12.11 ^{***}	
Time in Care				6.43 ^{***}	1.80				4.79 ^{***}	1.46
Child care hours	.18 ^a (.05)	.02 ^b (.04)	.13 ^a (.03)	20.33 ^{***}	4.89 ^{**}	.20 ^a (.05)	.02 ^b (.04)	.12 (.04)	21.67 ^{***}	5.20 ^{**}
Child care hours squared	.007 (.004)	.004 (.003)	-.001 (.002)	4.21 [*]	2.26	.008 (.004)	.004 (.003)	.001 (.002)	5.41 [*]	1.47
Prop time in care	-.39 (1.04)	2.96 (1.45)	-.26 (1.74)	.85	1.94	-.69 (1.07)	2.53 (1.38)	-.48 (1.78)	.29	1.86
Child care hours by prop time in care	-.00 (.10)	.02 (.10)	.04 (.10)	.08	.05	-.01 (.10)	.05 (.09)	.00 (.11)	.07	.09
Child Characteristics										
Male	1.69 ^a (.80)	2.00 ^a (.87)	-.59 ^b (.70)	3.71	3.95 [*]	1.65 (.81)	1.60 (.74)	-.76 (.70)	2.68	4.12 [*]
Race/Ethnicity				0.14	0.82				.12	1.10
Family Characteristics										
Maternal education	-.22 (.21)	-.04 (.20)	-.14 (.18)	.93	.27	-.26 (.22)	-.04 (.19)	-.18 (.19)	1.41	.44
Partner in household	.71 (1.26)	.02 (1.19)	-1.58 (1.09)	.14	1.09	1.03 (1.28)	.11 (1.13)	-1.06 (1.14)	.00	.78
Income/needs	.25 (.21)	-.16 (.21)	.28 (.19)	.77	1.78	.27 (.22)	-.14 (.20)	.22 (.20)	.71	1.65

Table 4 (cont.)

Repeated Measures Analysis Relating Predictor Variables to Externalizing Behavior at 24, 36, and 54 months (*n*=941).

	Model 1					Model 2				
	Coefficients (se)			F statistic		Coefficients (se)			F statistic	
	24 m	36 m	54 m	Main Effect	Age Intrctn	24m	36m	54m	Main Effect	Age Intrctn
Family Characteristics (cont.)										
Poverty status	1.99 (1.28)	1.18 (1.27)	2.90 (1.18)	7.15**	.52	1.97 (1.31)	1.70 (1.11)	3.04 (1.12)	9.55**	.42
Maternal depression	.27 (.37)	.32 (.37)	.48 (.35)	2.46	.10	.35 (.38)	.25 (.35)	.55 (.36)	2.91	.20
Parenting quality	-1.80 (.84)	-2.19 (.69)	-1.64 (.55)	18.39***	.22	-1.88 (.87)	-1.59 (.56)	-1.51 (.55)	15.75***	.07
Site				1.24					1.23	
Child Care										
Quality	-.41 (1.06)	-.35 (1.00)	-.11 (.68)	.26	.03	.10 (1.10)	-.64 (.93)	.09 (.70)	.07	.24
Center Care	-.86 (.92)	-2.40 (.78)	-2.31 (.94)	11.17***	1.10	-1.12 (1.13)	-3.00 (1.08)	-3.98 (1.07)	17.23***	1.74
Prop time w/large group						1.70 (1.25)	1.66 (1.54)	3.08 (1.24)	7.01**	.40
Hypothesized Interactions										
Hours x Gender	-.02 (.08)	-.09 (.07)	-.003 (.05)	.73	.60					
Hours x Poverty	-.06 (.11)	.02 (.08)	-.002 (.07)	.07	.17					
Hours x Parenting	-.03 (.08)	.09 (.05)	.01 (.04)	.38	1.30					

Table 4 (cont.)

Repeated Measures Analysis Relating Predictor Variables to Externalizing Behavior at 24, 36, and 54 months ($n=941$).

	Model 1					Model 2				
	Coefficients (se)			F statistic		Coefficients (se)			F statistic	
	24 m	36 m	54 m	Main Effect	Age Intrctn	24	36	54	Main Effect	Age Intrctn
Hours x CC Quality	-.13 (.10)	-.10 (.07)	-.04 (.05)	4.10*	.52	-.08 (.10)	-.08 (.07)	-.05 (.05)	2.32	.09
Hours x Prop time w/large group						.23 (.10)	.01 (.09)	.17 (.01)	5.73*	1.63

Note: Dummy variables for site and ethnicity are included in these models. However, neither was significant and their multiple coefficients are not listed to save space. F(main) is the test of the main effect of that predictor over time (between-subjects test) and F(age) is the test whether the predictor is related to the outcome differently over time (within-subjects test). Superscripts indicate differences among coefficients across age and should be used to interpret age interactions. More specifically, when superscripts are the same (e.g., Age at 24 and 54 months), the coefficients are not significantly different from one another; when the superscripts are different (e.g., Age at 24 and 36 months), the coefficients are significantly different from one another.

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure Captions

Figure Captions

Figure 1. Predicted externalizing growth curves for a prototypical child with 10, 20, 30, 40, or 50 hours in child care per week.

Figure 2. Predicted externalizing scores from child care when quality is low (-1 SD), average (mean), and high (+1 SD).

Figure 3. Predicted externalizing scores from child care when proportion of time in care with large group of peers is low (-1 SD), average (mean), and high (+1 SD).

Figure 1

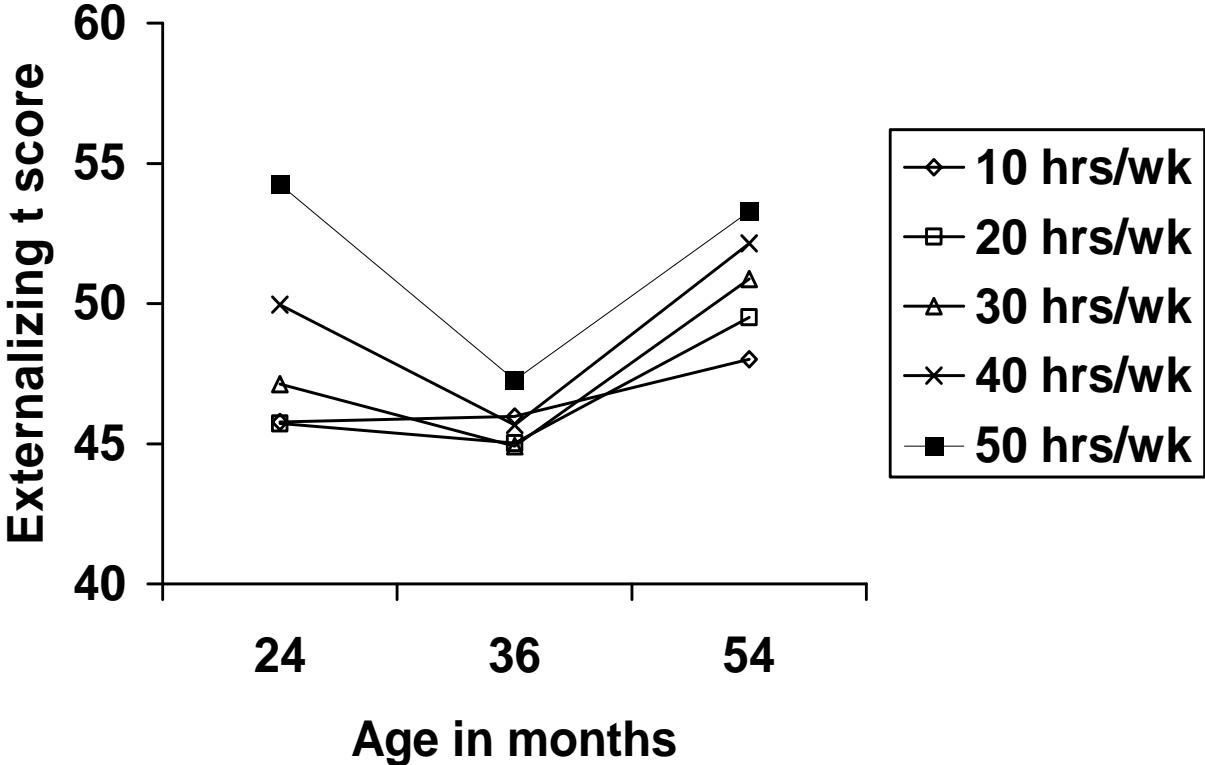


Figure 2

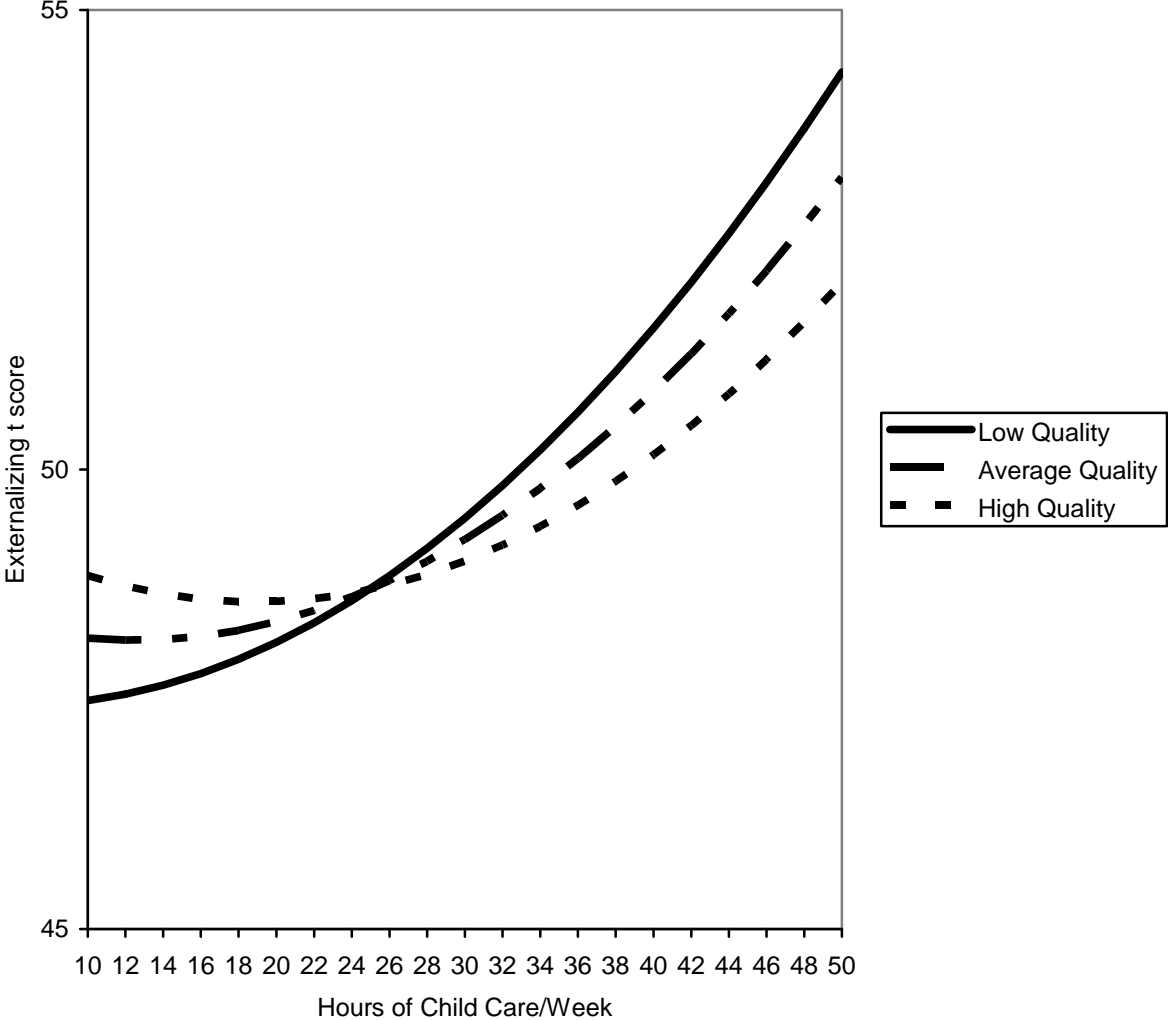
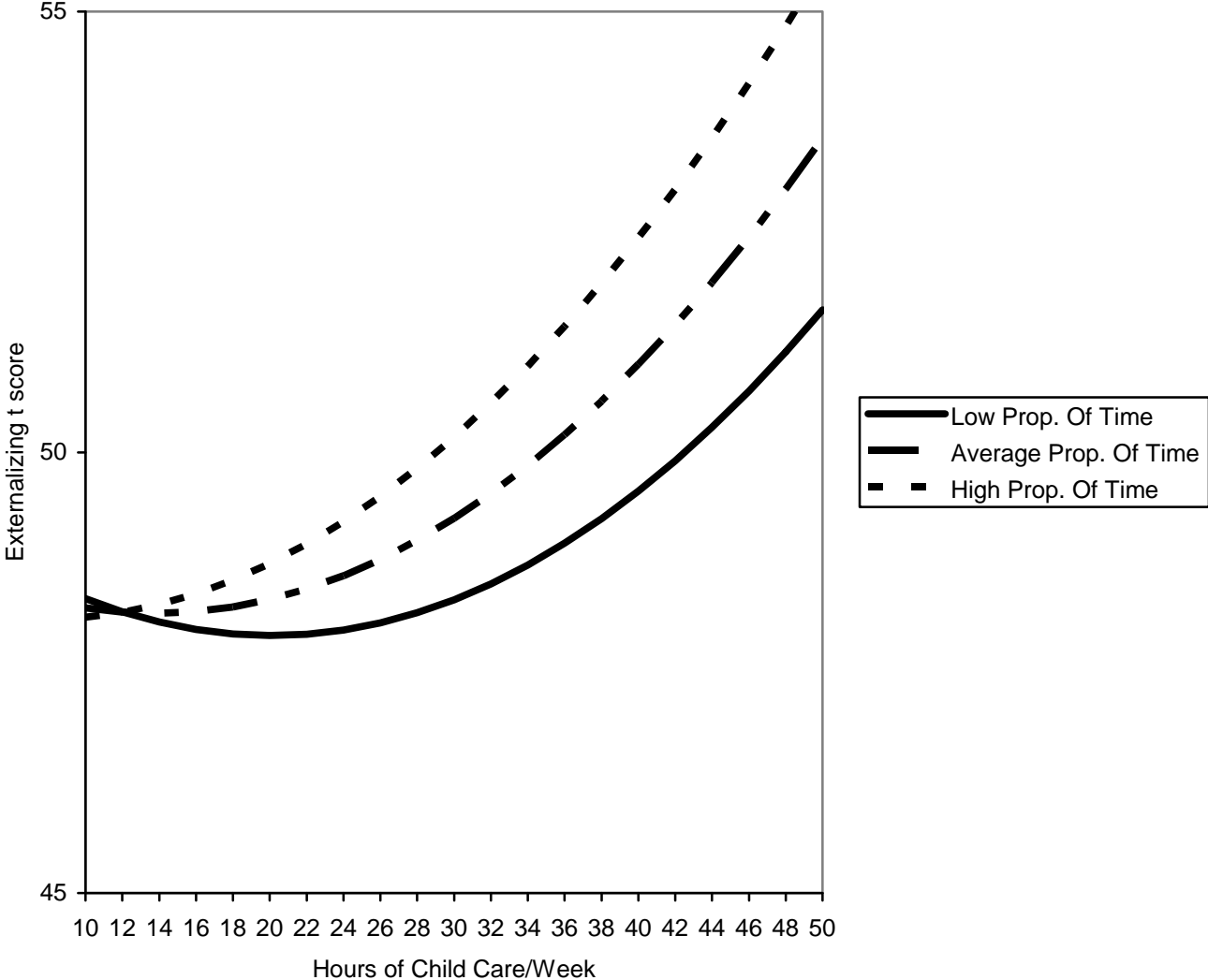


Figure 3



Appendix A

Table A1

Intercorrelations among provider ratings of externalizing behavior at 24 months, child care experiences between 6 and 24 months, and child and family demographics.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Externalizing	--													
2. CC hours/ week	.16													
3. Prop time in child care	-.05	.38												
4. Center care	-.04	.07	-.01											
5. Quality	-.11	-.12	.04	-.27										
6. Increased hours	.01	.11	-.14	-.06	.01									
7. Decreased hours	-.06	-.13	.18	-.12	-.07	-.78								
8. Prop time in large group	.02	.12	.03	.60	-.29	-.10	.14							
9. Male	.07	.01	-.01	-.00	-.04	-.06	.05	.03						
10. Education	-.18	-.04	.23	.05	.23	-.12	.17	.08	-.07					
11. Partnered	-.05	-.07	.06	-.04	.20	-.14	.12	-.07	-.04	.20				
12. Inc to Needs	-.07	.10	.21	.04	.26	-.08	.08	.00	-.10	.54	.32			
13. Poverty	.12	-.12	-.28	.01	-.22	.11	-.06	.00	.08	-.43	-.36	-.58		
14. Depression	.08	.06	-.09	.05	-.16	.15	-.15	.08	-.07	-.17	-.22	-.22	.18	
15. Parenting	-.23	-.07	.17	.03	.37	-.11	.11	.01	-.09	.53	.33	.49	-.48	-.25

Bolded if $p < .05$

Table A2

Intercorrelations among provider ratings of externalizing behavior at 36 months, child care experiences between 6 and 36 months, and child and family demographics.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Externalizing	--													
2. CC hours/ week	.10													
3. Prop time in child care	.04	.08												
4. Center care	-.10	.06	.06											
5. Quality	-.12	-.16	.02	-.10										
6. Increased hours	.03	-.02	-.30	-.03	-.07									
7. Decreased hours	-.05	.02	.14	.04	.07	-.55								
8. Prop time in large group	-.06	.08	.09	.75	-.09	-.11	.11							
9. Male	.10	.01	-.02	-.00	.03	-.07	-.02	.01						
10. Education	-.16	-.08	.14	.06	.16	-.20	.10	.11	-.02					
11. Partnered	-.10	-.12	.08	-.09	.08	-.10	.04	-.09	-.02	.22				
12. Inc to Needs	-.17	.04	.12	.11	.15	-.21	.10	.11	-.07	.54	.37			
13. Poverty	.17	-.03	-.17	-.03	-.16	.22	-.11	-.06	.05	-.46	-.46	-.63		
14. Depression	.11	.05	-.07	-.02	-.07	.08	-.09	.01	-.02	-.22	-.18	-.19	.21	
15. Parenting	-.26	-.13	.09	.01	.26	-.17	.09	.01	-.08	.47	.28	.44	-.43	-.29

Bolded if $p < .05$

Table A3

Intercorrelations among provider ratings of externalizing behavior at 54 months, child care experiences between 6 and 54 months, and child and family demographics.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Externalizing	--													
2. CC hours/ week	.25													
3. Prop time in child care	.02	.26												
4. Center care	-.15	-.20	.05											
5. Quality	-.12	-.19	.03	.21										
6. Increased hours	.03	.19	.07	-.02	-.01									
7. Decreased hours	-.07	-.09	-.03	.02	.04	-.58								
8. Prop time in large group	.02	-.17	-.04	.43	.03	-.21	.16							
9. Male	-.03	-.01	.02	-.01	-.02	.03	.00	.03						
10. Education	-.19	-.07	.13	.06	.13	-.18	.15	.13	-.01					
11. Partnered	-.18	-.16	.06	.10	.14	-.08	.05	-.05	.01	.25				
12. Inc to Needs	-.11	-.02	.10	.08	.11	-.21	.17	.15	-.00	.57	.33			
13. Poverty	.20	.06	-.08	-.08	-.10	.20	-.11	-.05	.01	-.48	-.39	-.62		
14. Depression	.14	.09	-.04	-.01	-.01	.08	-.08	-.04	-.03	-.22	-.13	-.22	.22	
15. Parenting	-.26	-.11	.08	.07	.11	-.18	.22	.06	-.01	.50	.29	.43	-.48	-.23

Bolded if $p < .05$