

## TRAJECTORIES OF CHANGE IN ATTACHMENT AND BIOBEHAVIORAL CATCH-UP AMONG HIGH-RISK MOTHERS: A RANDOMIZED CLINICAL TRIAL

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**ABSTRACT:** Using an intensive short-term longitudinal design, this study first examined whether there were significant differences in maternal sensitivity and intrusiveness after completion of Attachment and Biobehavioral Catch-up (ABC; Dozier & the Infant-Caregiver Project Lab, 2013) when compared to a control condition. The second aim was to explore the rate and shape of change in parenting behaviors. Participants were 24 mothers and their biological children, who were randomly assigned to ABC ( $n = 13$ ) or a control condition ( $n = 11$ ). A structured play assessment with each mother and her child was video-recorded prior to randomization into the study, before each intervention session, and at a follow-up visit. A total of 270 videos were coded for sensitivity and intrusiveness. Hierarchical linear growth models were used to estimate the total change in parenting qualities across the 10 intervention sessions when comparing ABC to a control condition. Piecewise hierarchical linear growth models were used to investigate patterns of change across the intervention for mothers within ABC. Mothers in the ABC condition showed greater increases in sensitivity and decreases in intrusiveness than mothers in the control condition. There was evidence for nonlinear patterns of change in sensitivity and intrusiveness among mothers in ABC. These results support the effectiveness of ABC in changing sensitivity quickly.

**Keywords:** intervention research, parenting, randomized controlled trial

**RESUMEN:** Por medio del uso de un diseño longitudinal intensivo a corto plazo, este estudio examinó si había significativas diferencias en la sensibilidad e intrusión materna después de completar la medida ABC (Alcance de Afectividad y Bio-Conducta) al compararse con una condición de control. La segunda meta fue explorar la tasa y forma del cambio en conductas de crianza. Las participantes fueron 24 madres y sus niños biológicos asignadas al azar al grupo ABC ( $n = 13$ ) o a una condición de control ( $n = 11$ ). Previo a la asignación al azar como parte del estudio, antes de cada sesión de intervención y durante una visita de seguimiento, se grabó en video una estructurada evaluación de juego. Se codificó un total de 270 videos en cuanto a sensibilidad e intrusión. Se usaron modelos de crecimiento lineal jerárquico para estimar el cambio total en las cualidades de crianza a través de las 10 sesiones de intervención cuando se comparó el grupo ABC con el grupo en condición de control. Se usaron pedazos de modelos de crecimiento lineal jerárquico para investigar patrones de cambio a través de la intervención para madres dentro del grupo ABC. Las madres en la condición ABC mostraron un mayor aumento en la sensibilidad y una baja en la intrusión que las madres en la condición de control. Se dio evidencia de patrones de cambios no lineales en la sensibilidad y la intrusión entre las madres del grupo ABC. Estos resultados apoyan la efectividad de ABC en cambiar la sensibilidad rápidamente.

**Palabras claves:** investigación de intervención, crianza, intento aleatorio controlado

**RÉSUMÉ:** Utilisant une structure longitudinale intensive à court terme, cette étude a d'abord examiné s'il existait des différences importantes entre la sensibilité maternelle et l'intrusion après avoir complété le *Attachment and Biobehavioral Catch-Up* (ABC, en anglais, soit Rattrapage d'Attachement et Biocomportemental) lorsque comparées à des conditions de contrôle. Le deuxième but était d'explorer le taux et la forme du changement dans les comportements parentaux. Les participants ont consisté en 24 mères et leurs enfants biologiques qui ont été assignés au groupe ABC ( $n = 13$ ) ou à une condition de contrôle ( $n = 11$ ). Une évaluation de jeu structuré avec chaque mère et son enfant a été enregistrée à la vidéo avant que les groupes soient séparés au hasard pour l'étude, avant chaque séance d'intervention, et à une visite de suivi. Au total, 270 vidéos ont été codées pour la sensibilité et l'intrusion. Des modèles de croissance linéaire hiérarchique ont été utilisés afin d'estimer le changement total dans les qualités de parentage au travers de 10 séances d'intervention en comparant l'ABC à la condition de contrôle. Des modèles de croissance linéaire par pièce ont été utilisés afin de

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rechercher les patterns de changement au travers de l'intervention pour les mères du groupe ABC. Les mères dans la condition ABC ont fait preuve de plus d'augmentations dans la sensibilité et de baisses dans l'intrusion que les mères dans la condition de contrôle. On a trouvé des patterns nonlinéaires de changement dans la sensibilité et l'intrusion chez les mères du groupe ABC. Ces résultats soutiennent l'efficacité de l'ABC à faire changer la sensibilité rapidement.

**Mots clés:** recherches sur l'intervention, parentage, étude contrôlée randomisée

**ZUSAMMENFASSUNG:** Mittels eines intensiven, longitudinalen Kurzzeitdesigns untersuchte die Studie zunächst, ob es nach Abschluss des Programms "Attachment and Biobehavioral Catch-Up" (ABC) verglichen mit einer Kontrollbedingung signifikante Unterschiede in der mütterlichen Feinfühligkeit und Intrusivität gab. Das zweite Ziel war es, die Geschwindigkeit und Form der Veränderung des Erziehungsverhaltens zu erforschen. Die Teilnehmer waren 24 Mütter und ihre biologischen Kinder, die randomisiert der "ABC" (n = 13) oder einer Kontrollbedingung (n = 11) zugewiesen wurden. Die Erhebung des strukturierten Spielverhaltens jeder Mutter und ihres Kindes fand vor der Randomisierung zur Studie, vor jeder Interventionssitzung und bei einem Follow-up-Besuch per Videoaufnahme statt. Insgesamt wurden 270 Videos für Feinfühligkeit und Intrusivität kodiert. Für den Vergleich der "ABC"-Gruppe mit der Kontrollgruppe wurden hierarchische lineare Wachstumsmodelle verwendet, um die Gesamtveränderung der Erziehungsqualitäten über die 10 Interventionssitzungen zu schätzen. Abschnittsweise wurden hierarchische lineare Wachstumsmodelle verwendet, um Veränderungsmuster bei den "ABC"-Müttern während der Intervention zu untersuchen. Die Mütter in der "ABC"-Gruppe zeigten eine höhere Zunahme der Feinfühligkeit und einen stärkeren Rückgang der Intrusivität als die Mütter in der Kontrollbedingung. Es gab Hinweise für nicht-lineare Veränderungsmuster der Feinfühligkeit und Intrusivität bei den Müttern in der "ABC"-Gruppe. Diese Ergebnisse unterstützen die Effektivität des "ABC"-Programms, indem die Feinfühligkeit schnell verändert werden konnte.

**Stichwörter:** Interventionsforschung, Erziehung, randomisierte kontrollierte Studie

抄録: 集中的な短期縦断研究デザインを用いて、この研究は最初に、対照条件と比較したとき、愛着と生物行動学的キャッチアップ Attachment and Biobehavioral Catch-Up (ABC)の完了後に、母親の感受性と侵入性に有意差があるかどうかを検証した。第2の目的は、養育行動における変化の割合と形を探索することである。参加したのは24人の母親とその生物学的な子どもで、ABC (n = 13) が対照条件 (n = 11) にランダムに割り当てられた。それぞれの母親とその子どもの構造化したプレイの評価が、ランダム化研究に入る前、それぞれの介入セッションの前およびフォローアップ訪問の時に、ビデオ撮影された。全部で270本のビデオが感受性と侵入性についてコード化された。ABCと対照条件を比較したとき、階層的線形成長モデルが、10回の介入セッションを通して養育の質の全変化を推測するために使われた。区分的階層的線形成長モデルが、ABCの中で母親達の介入を通じての変化のパターンを調査するために使われた。ABC条件の母親は、対照条件の母親よりも、感受性が大きく増加し、侵入性が低下した。ABCの母親には、感受性と侵入性の変化のパターンに非線形パターンの根拠があった。これらの結果はABCが感受性を素早く変化させる上で有効であることを支持した。

**キーワード:** 介入研究, 養育(育児), ランダム化対照研究

摘要: 本研究使用一個密集的短期縱向設計, 首先檢查完成依附和生物行為追趕式干預(ABC)是否與對照組在母體靈敏度和侵擾性有顯著差異。第二個目的是探討育兒行為的變化速度和特性。參與研究者24名母親及其親生子女, 被隨機分配到ABC組 (N = 13) 或對照組 (N = 11)。在隨機分組前、每一個干預會議前, 並在跟進訪問時, 作者為每個媽媽和她的孩子的結構化遊戲評估進行視頻錄製。並為270個視頻靈敏度和侵擾性的編碼。作者用分層線性增長模型來比較ABC組和對照組在10個干預會議中育兒素質的整體變化。又以分段分層線性增長模型來探討整個干預對ABC組母親的改變。比對照組母親, ABC組母親較多增加靈敏度和減小侵擾性。證據顯示ABC組母親的靈敏性和侵入性有非線性模式的變化。這些結果支持ABC在快速變化的敏感性的有效性。

**關鍵詞:** 干預研究, 育兒, 隨機對照試驗

**الهدف:** استخدمت هذه الدراسة تصميم طولي قصير الأمد لاختبار ما إذا كان هناك فروق إحصائية في الحساسية والتدخل الأمومي بعد إتمام برنامج التعلق واللاحق البيوسلوكي (ABC) بالمقارنة مع مجموعة ضابطة. الهدف الثاني من الدراسة استكشاف معدل وشكل التغيير في سلوكيات الأمومة. اشتملت عينة الدراسة على 24 أم وأطفالهم البيولوجيين والذين تم توزيعهم عشوائياً إلى مجموعة تجريبية (13) ومجموعة ضابطة (11). تم تسجيل فيديو لجلسات اللعب المنظم مع كل أم وطفلها قبل إجراء عشوائية العينة وقبل كل جلسة تدخل وفي زيارة المتابعة. وبذلك تم تحليل 270 فيديو من حيث متغيرات الحساسية والتدخل عند الأم. وتم استخدام نموذج النمو الخطي الهرمي لتحديد مقدار التغيير في جودة الأمومة خلال جلسات التدخل العشرة مع مقارنة المجموعة التجريبية (مجموعة التعلق واللاحق البيوسلوكي ABC) بالمجموعة الضابطة. واستخدم نموذج النمو الخطي الهرمي الدالي متعدد التعريف وذلك لاستكشاف أنماط التغيير نتيجة التدخل للأمهات في مجموعة ABC. أظهر الأمهات في مجموعة ABC زيادات أكبر في الحساسية وتناقص في التدخل مقارنة بالأمهات في المجموعة الضابطة. وكان هناك دلالات على أنماط غير نظامية من التغيير في الحساسية والتدخل بين أمهات ABC. هذه النتائج تدعم فاعلية ABC في تغيير الحساسية بشكل سريع.

**كلمات مفتاحية:** أبحاث التدخل – الأبوة والأمومة – عشوائية التجربة المنظمة

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Children who have experienced early adversity, such as neglect, are at high risk for negative outcomes across multiple domains (Ehlert, 2013). Neglected children have a greater probability of developing disorganized attachments (Carlson, 1998; van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999), experiencing disruptions in hypothalamic–pituitary–adrenal (HPA) axis functioning (Dozier et al., 2006; Dozier, Peloso, Lewis, Laurenceau, & Levine, 2008; Bosch et al., 2012), and are at greater risk for mortality due to chronic diseases (Miller, Chen, & Parker, 2011) than are children who receive adequate parental care. Parenting interventions have shown promise in ameliorating such outcomes among children who have experienced early adversity (Barlow, Parsons, & Stewart-Brown, 2005; Juffer, Bakermans-Kranenburg, & van IJzendoorn, 2005). Attachment and Biobehavioral Catch-up (ABC), an intervention for high-risk parents and children, has been shown to be effective in increasing the proportion of children who form secure attachments to their parents (Bernard et al., 2012) and in improving children’s ability to regulate physiology (Bernard, Dozier, Bick, & Gordon, 2015; Bernard, Hostinar, & Dozier, 2015) and emotions (Lind, Bernard, Ross, & Dozier, 2014) through randomized clinical trials. To further our understanding of the processes by which these changes come about through ABC, the current study examined whether changes in parenting behavior emerged and investigated trajectories of change in parenting behaviors across the 10-session intervention. Such process-oriented research questions can provide clues as to when the most change occurs (Hayes, Miller, Hope, Heimberg, & Juster, 2008; Laurenceau, Hayes, & Feldman, 2007).

### THE NEED FOR PARENTING INTERVENTIONS

In 2012, over 2 million cases of child maltreatment were reported and investigated by child protective service agencies within the United States (U.S. Department of Health and Human Services, 2013). Of these cases, 78.3% were classified as child neglect. Children younger than 1 year of age had the highest victimization rate (21.9 per 1,000 children). Poverty (Slack, Holl, McDaniel, Yoo, & Bolger, 2004), community characteristics (Ernst, Meyer, & DePanfilis, 2004), prevalence of domestic violence (Shepard & Raschick, 1999), and parent substance abuse (Jaudes, Ekwo, & Van Voorhis, 1995) undermine parenting abilities and place children at risk for neglect. Without intervention, neglecting parents do not have the resources needed to provide sensitive and nurturing care that is required for children’s optimal development (Hildyard & Wolfe, 2002).

During the first year of life, infants form an attachment to caregivers that is based on experiences of their caregivers’ availability and support, especially in times of distress (Ainsworth, Blehar, Waters, & Wall, 1978). Attachment quality varies and is associated with differences in later social, emotional (Bohlin, Hagekull, & Rydell, 2000; Urban, Carlson, Egeland, & Sroufe, 1991; Verissimo, Santos, Fernandes, Shin, & Vaughn, 2014), and academic functioning (Jacobsen & Hofmann, 1997). Organized attachments, which include secure or insecure (i.e., avoidant and resistant) classifica-

tions, are marked by a child behaving in a predictable way with his or her caregiver, especially when the infant is in distress (Carlson, 1998). More specifically, secure attachment is marked by a child seeking comfort from his or her parent when distressed and calming down after receiving the comfort. Alternatively, children with an insecure attachment may actively avoid comfort from their caregiver when in distress or may initiate comfort from their caregiver, but have difficulty calming down.

Some infants, however, show a breakdown in their otherwise predictable behavior with their caregiver or show a lack of a coherent emotion regulation strategy that can be used during stressful situations, such as unusual behaviors (e.g., freezing, stilling) or engaging in inconsistent behaviors, which is known as disorganized attachment (Carlson, 1998). Disorganized attachment has been linked with a higher incidence of externalizing symptoms (Lyons-Ruth, Alpern, & Repacholi, 1993; Pasco Fearon & Belsky, 2011), internalizing symptoms (Brumariu & Kerns, 2013; Kerns & Brumariu, 2014; Lecompte, Moss, Cyr, & Pascuzzo, 2014), and dissociative symptoms (Carlson, 1998) than organized attachment. Links between early attachment disorganization and the development of psychopathy in adults are also beginning to surface (Schimmenti et al., 2014). Children in high-risk environments, such as those with neglecting birth parents, are more likely to develop disorganized attachments than are children in low-risk environments (Cyr, Euser, Bakermans-Kranenburg, & van IJzendoorn, 2010).

Parental behaviors have long been ascribed as the mechanism for individual differences in children’s attachment development. For instance, one important determinant of secure attachment is parental sensitivity, or the caregiver’s ability to respond appropriately to his or her child’s signals (Ainsworth et al., 1978). Parental frightening behaviors have explicitly been shown to predict disorganized attachment (van IJzendoorn et al., 1999). Frightening behaviors can include both physical and verbal behaviors. Examples of frightening behaviors include intensely tickling a child while the caregiver ignores the child’s cues to stop, threatening a child, or physically harming a child. Main and Hesse (1990) postulated that this creates a “fright without solution” paradox in infants, where the caregiver is both a source of fear and protection for the child, resulting in disorganized attachment. Insensitive parenting, or not responding appropriately to a child’s signals, has also been identified as a predictor of later disorganized attachment classifications (van IJzendoorn et al., 1999). These findings highlight the need for interventions aimed at improving caregiving qualities in order to disrupt the adverse pathway, especially in high-risk populations.

### ATTACHMENT AND BIOBEHAVIORAL CATCH-UP

In response to the need to improve caregiving qualities in high-risk populations, several interventions have incorporated increasing sensitivity as an important target in populations of children at-risk for developing disorganized attachments (Bick & Dozier, 2013; Toth, Gravener-Davis, Guild, & Cicchetti, 2013). ABC aims

to improve caregiving quality through promoting three intervention targets identified as playing a key role in a child's development when faced with early adversity. Specifically, ABC encourages parents to behave in sensitive and delighted ways when a child is not distressed, provide nurturance when a child is distressed, and reduce frightening behavior at all times (Dozier & the Infant-Caregiver Project Lab, 2013). Parent coaches gradually incorporate intervention targets into each session's goals using various strategies, including discussion of research findings, video demonstrations of other parents and children, and video clips from previous sessions. A key strategy thought to lead to changes in parenting behaviors is parent coaches' "In the Moment" commenting (Meade & Dozier, 2012). Throughout the intervention, parent coaches are expected to provide feedback to parents on behaviors that are targeted by ABC. Initially, parent coaches point out parents' naturally occurring behaviors as they meet the intervention targets. Once rapport has been established, parent coaches use scaffolding techniques to encourage on-target behaviors when parents fail to behave in nurturing, sensitive, and non-frightening ways.

ABC has demonstrated efficacy with respect to children's HPA axis functioning, attachment behaviors, and executive functioning. In relation to children's HPA axis functioning, children whose parents received the ABC intervention showed a higher wake-up cortisol value and steeper slope than those assigned to a control condition (Bernard, Dozier, Bick, & Gordon, 2015). Patterns of higher wake-up cortisol values and steeper slopes are normative for HPA axis functioning in typically developing children and differentiate low- and high-risk children (Bernard, Butzin-Dozier, Rittenhouse, & Dozier, 2010; Gunnar & Donzella, 2002). Changes in cortisol production have also been shown to persist for 3 years after intervention completion (Bernard, Hostinar, & Dozier, 2015). Second, over 50% of children whose parents were randomly assigned to ABC were found to have secure attachments, as compared to 33% in the control condition (Bernard et al., 2012). Finally, Lewis-Morrarty, Dozier, Bernard, Terracciano, and Moore (2012) demonstrated long-lasting change on children's executive functioning, such that 5-year-olds whose foster parents had completed ABC performed better on two executive functioning tasks than did children whose foster parents received the control condition.

Despite the extensive evidence base linking ABC with positive child outcomes, there has been limited study of the effects of ABC on parental sensitivity. Through a randomized clinical trial, Bick and Dozier (2013) examined foster parents' sensitivity to their children's cues during a 10-minute play task; foster parents who were randomized into ABC showed greater improvements in sensitive behavior during the play interaction than foster parents who received the control condition.

### PSYCHOTHERAPY PROCESS RESEARCH

A necessary next step to understand efficacious treatments is to identify when and how change occurs (Kazdin, 2001; Laurenceau, Hayes, & Feldman, 2007). Psychotherapy process research can

influence the development and implementation of interventions (Laurenceau, Hayes, & Feldman, 2007) and provide useful information to clinicians, such as when change should occur during a treatment so that treatment approaches can be adjusted accordingly (Hayes et al., 2008). Moreover, therapeutic change is not always a linear process (Hayes, Laurenceau, Feldman, Strauss, & Cardaciotto, 2007). For example, in exposure-based cognitive therapy for depression, Hayes, Feldman, et al. (2007) found a cubic pattern of change in patients' depression symptoms, such that patients experienced an initial decrease in symptomatology, followed by an increase, and finally, another decrease in symptoms. To achieve a more thorough understanding of patterns of change, more intensive study is necessary.

Although an increase in the importance of psychotherapy process research has arisen, few studies investigating such questions as they relate to parenting interventions have been published. Parent-child interaction therapy (PCIT) is one intervention that has recently employed a more intensive longitudinal design to assess when change occurs within treatment. Specifically, Hakman, Chaffin, Funderburk, and Silovsky (2009) indicated that significant improvements in parenting behavior occurred within the first three sessions, with no significant change occurring during the remainder of the intervention. Although PCIT is different from ABC in that it was developed to improve childhood disruptive behavior problems through the enhancement of parenting behaviors and the use of a time-out procedure (Brinkmeyer & Eyberg, 2003), parent change has been found to be mediated by in vivo feedback, or "coaching" of parenting behaviors during sessions (Barnett, Niec, & Acevedo-Polakovich, 2014), which is similar to what is thought to be the active ingredient for change in ABC (i.e., In the moment commenting). Furthermore, studies assessing when change occurs among other interventions and therapies for children and adolescents have shown support for improvements early within the process (Eddy, Dishion, & Stoolmiller, 1998; Gallo, Cooper-Vince, Hardway, Pincus, & Comer, 2014).

### THE CURRENT STUDY

Given ABC's efficacy as an intervention improving child outcomes and caregiving behaviors, one necessary next step in understanding how ABC works is to focus on session-by-session change in parenting behaviors. The first aim of the current study was to investigate whether ABC showed significant changes in parenting behaviors when compared to a control condition. More specifically, we hypothesized that mothers randomized into ABC would show significant increases in overall levels of sensitivity (H1) and significant decreases in overall levels of intrusiveness (H2) when compared to a control condition. A second aim of the current study was to examine the rate and shape of change, as well as when the most change occurred in parenting behaviors across the 10 intervention sessions for mothers who were randomized into ABC only. Given that research has suggested change occurs earlier rather than later in treatment, a nonlinear, or two-piece, model of change in parenting behavior was hypothesized for change in sensitivity (H3) and

**TABLE 1.** Demographic Characteristics by Intervention Group

Variable	ABC ( <i>n</i> = 13)	DEF ( <i>n</i> = 11)	Test of Difference
Maternal Age (years)	24.70 (4.19)	28.82 (7.09)	$t(22) = 1.77, p = .09$
Child Age (months)	13.18 (4.38)	15.14 (3.64)	$t(22) = 1.18, p = .25$
Child Race			$\chi^2(3, 24) = 2.04, p = .57$
African American	46.2 (6)	63.6 (7)	
European American	38.5 (5)	36.4 (4)	
Biracial	7.7 (1)	0	
Other	7.7 (1)	0	
Child Gender			$\chi^2(2, 24) = .62, p = .43$
Male	61.5 (8)	45.5 (5)	
Female	38.5 (5)	54.5 (6)	
Household Income	\$11,015.54 (\$8,438.78)	\$13,688.89 (\$11,463.91)	$t(22) = .63, p = .54$
Household Education			$\chi^2(2, 24) = 1.58, p = .66$
Did Not Complete High School	30.8 (4)	18.2 (2)	
High School or GED	46.2 (6)	36.4 (4)	
Some College	15.4 (2)	36.4 (4)	
College or Technical School	7.7 (1)	9.1 (1)	

ABC = Attachment and Biobehavioral Catch-up; DEF = Developmental Education for Families.

intrusiveness (H4). More specifically, significant improvements in parenting behavior would occur early in treatment (Sessions 1–5) versus later in treatment (Sessions 5–10).

## METHOD

### Participants

Twenty-four mothers and their biological children participated in the current study. After consenting to the study, 13 mothers were randomized into ABC, and 11 mothers were randomized into a control condition (Developmental Education for Families; DEF; discussed later). One family from ABC only completed three intervention sessions, and one family from DEF only completed four intervention sessions. The groups did not differ on demographic variables (Table 1).

### Procedures

**Referral and screening process.** From December 2013 through July 2014, eligible participants were referred to study staff by the Division of Family Services if they had an unsubstantiated report of neglect within the state of Delaware. Research staff contacted eligible participants via regular mail and telephone calls and scheduled a screening interview for interested mothers. All participants signed informed consent forms prior to completion of the screening visit. Forty-two screening visits were completed in mothers' homes by a research staff member. A brief demographic questionnaire assessing multiple factors, including household income, sources of income, and age of the child, was completed with the mother. Next, a 7-minute play assessment of sensitivity and intrusiveness was conducted and coded while in the home. Based on results of these behavioral and demographic screenings, eligible mothers were invited to participate in the study. Eligibility criteria

included: if a mother had a child between the ages of 6 and 20 months, reported household income of less than \$35,000, and evidenced low levels of sensitive behaviors (score of  $\leq 3$  on the Sensitivity scale) or high levels of intrusive behaviors (score of  $\geq 3$  on the Intrusiveness scale). These criteria were used in order to include a sample of mothers most likely to benefit from an intervention targeting improvements in sensitivity and decreasing intrusive behaviors. Seven mothers were excluded at the screening visit due to household incomes of more than \$35,000, and 3 mothers were excluded because they did not meet the parenting behavior criteria. After consent to participate in one of the two study groups was obtained, participants were stratified by race and then randomly assigned to receive either the ABC or the DEF intervention.

**Data collection.** Demographic questionnaires were completed during the screening visit. Seven-minute play assessments were collected at screening, prior to each intervention session, and at a post-intervention visit. Twelve mothers (92.3%) completed all 10 intervention sessions of ABC, and 10 mothers (90.9%) completed all 10 intervention sessions of DEF. Average time to completion from Session 1 to the follow-up visit for ABC was 18.8 weeks ( $SD = 5.2$ , range = 9.7–27.1). Average time to completion from Session 1 to the follow-up visit for DEF was 16.1 weeks ( $SD = 3.5$ , range 12.0–24.1). Time from intervention Session 1 to the follow-up visit was not significantly different between groups,  $t(22) = -1.40, p = .18$ .

### Interventions

For both interventions, experienced interventionists adhered to an intervention manual and completed 10 weekly, hour-long sessions with parents in their homes. All sessions were video-recorded for fidelity checks.

*Experimental intervention.* ABC is an intervention conducted in the home that is aimed at teaching parents to provide nurturance to their children when they are distressed; respond in sensitive, contingent ways when children are not distressed; delight in their children; and behave in non-frightening ways. Specifically, Sessions 1 and 2 introduce the idea that children need nurturance even when they are not providing clear cues. During Sessions 3 and 4, mothers are encouraged to behave in sensitive and delighted ways by following children's lead. Sessions 5 and 6 help mothers identify and appropriately respond to children's signals while acknowledging that some play interactions can be frightening and/or intrusive. Sessions 7 and 8 are intended to provide a supportive context for mothers to explore their own experiences of being parented and how those experiences may interfere with their ability to meet intervention targets. Sessions 9 and 10 provide an additional opportunity for parent coaches to consolidate gains and focus more closely on specific areas with which mothers are still struggling, as well as a time to celebrate mothers' accomplishments (for a more detailed description of each session, see Bernard et al., 2012). Homework assigned each week facilitates further comprehension of intervention components that are focused on during the session.

*Control intervention.* DEF is an intervention conducted in the home and was adapted from previous interventions shown to improve children's gross and fine motor skills, cognition, and language abilities (Brooks-Gunn, Klebanov, Liaw, & Spiker, 1993). Specific activities completed with each child were adjusted according to the child's developmental level. The control intervention is structurally similar to ABC, such that it was a manualized treatment, included 10 intervention sessions that were 1 hour long, and had a parent coach interacting with the parent and child.

## Measures

*Demographics.* A brief questionnaire assessing demographic variables was administered to each mother. Variables of interest included mother and child ethnicity, mother and child date of birth, household income, sources of income, and mother's highest level of education.

*Parenting behavior.* Each mother was instructed to "Play with your child as you normally would for seven minutes," with a standardized set of toys. The standardized set of toys included two puppets, two rattle balls, two toy telephones, a piano, chirping eggs, and a light-up ring stacker. No specific instructions regarding proximity to the child or which toys to play with were given.

At study completion, 270 videos were collected and coded on Likert scales of 1 (demonstrates low levels of the behavior) to 5 (demonstrates high levels of the behavior) by 11 coders using an adapted version of the Observational Record of the Caregiving Environment (ORCE; NICHD Early Child Care Research Network, 1996). Constructs of interest included sensitivity and intrusiveness. Coders were blind to study condition, intervention session, date of collection, and study hypotheses. About 16% ( $n = 44$ ) of the play

assessments were double-coded and used to calculate a one-way random effects intraclass correlation (ICC) for each of the scales. Average ICCs were .61 for sensitivity and .77 for intrusiveness. Coders' ICCs ranged from 0.44 to 0.92 for sensitivity; however, it is important to note that the coder whose ICC was 0.44 only coded two videos used in the reliability analysis and only coded four videos of the full sample (two for ABC, two for DEF). Coders' ICCs ranged from 0.64 to 0.96 for intrusiveness.

The ORCE Sensitivity scale was used to measure mothers' ability to "follow the child's lead" or respond appropriately and contingently to the child's interests, cues, and capabilities. Mothers with high levels of sensitivity respond contingently to their child's nondistress play behaviors. For example, if a child plays keys on a toy piano, the mother also plays keys on the piano or comments on the child's playing. Low levels of sensitivity are characterized by mothers who engage in few, if any, instances of contingent play behaviors and are more likely to lead the interaction. At initial screening, mothers' level of sensitivity ranged from 1 to 4 ( $M = 1.96$ ,  $SD = .75$ ).

The ORCE Intrusiveness scale was used to measure mothers' level of intrusive or overstimulating behavior during the play interaction. Mothers with high levels of intrusiveness disregard a child's cues for disengagement or engage in unwanted physical contact with the child. For example, mothers may push a stuffed animal into a child's face or tickle the child. Low levels of intrusiveness are marked by few, if any, instances of verbally or physically intrusive behaviors. At initial screening, mothers' level of intrusiveness ranged from 1 to 5 ( $M = 3.38$ ,  $SD = 1.34$ ).

## Data Analytic Strategy

Hierarchical linear growth models were used to estimate change in sensitivity and intrusiveness after completion of the interventions using HLM7 Student Version software (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011), which allows sessions to be nested within individuals. Each outcome was entered as the dependent variable. The Level 1 (within-persons) variable was session. In all analyses, both the pre-intervention home-visit play assessment and the play assessment immediately before the first intervention session were coded as "0" so that HLM calculated an average level of parenting behavior before the intervention started. Next, sessions were scaled to represent the change in the outcome across a one-unit change in time and were spaced equally across this interval. This allowed for an assessment of the total average change in the outcome across the full intervention period. The Level 2 variable (between-persons) was intervention group. Linear growth models were specified separately for sensitivity and intrusiveness. Models were estimated using the following equations:

$$\text{Level 1 model: Behavior}_{i,t} = \pi_{0i} + \pi_{1i} \times (\text{SessionScaled}_{i,t}) + e_{i,t}$$

$$\text{Level 2 model: } \pi_{0i} = \beta_{00} + \beta_{01} \times (\text{Intervention}_i) + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11} \times (\text{Intervention}_i) + r_{1i}$$

In the Level 1 model, Behavior<sub>*t*</sub><sub>*i*</sub> represents the outcome at session *t* for each mother *i*.  $\pi_{0i}$  is the intercept or model-implied baseline level of behavior.  $\pi_{1i}$  is the slope coefficient for the total change in behavior across the 10 sessions.  $e_{ti}$  is the residual variance of mother *i*'s behavior at time *t* from her predicted growth trajectory. In the Level 2 model, the within-persons intercept,  $\pi_{0i}$ , is estimated by adding  $\beta_{00}$ , which represents the model-implied, fixed effect, baseline level of behavior for DEF,  $\beta_{01}$ , which represents the fixed effect difference between ABC and DEF at baseline levels of behavior, and  $r_{0i}$ , which represents the deviance for individual *i* from the predicted baseline level of behavior. Finally, the within-persons slope,  $\pi_{1i}$ , is estimated by adding  $\beta_{10}$ , the fixed effect change in behavior across the 10 sessions for the control group,  $\beta_{11}$ , the fixed effect difference between ABC and DEF's average behavior rate of change across the 10 sessions, and  $r_{1i}$ , which is the deviance for individual *i* from the average slope. Further, to assess how large the intervention effects were, an effect size was calculated using the formula  $d = \beta_{11}(\text{time})/SD_{\text{RAW}}$ , as described by Feingold (2009) for use with growth-modeling analyses.

Next, piecewise linear growth modeling, which allowed for the estimation of separate growth trajectories between different groupings of sessions (Raudenbush & Bryk, 2002), was used to explore when change occurred for mothers who were randomized into ABC only. Thus, we investigated whether the slope from assessments collected early in treatment (Sessions 1–5) were different than the slope from assessments collected later in treatment (Sessions 6–10). Intervention sessions were recoded to represent the two pieces of the linear growth model. The model was estimated using the following equations:

$$\text{Level 1 model: Behavior}_{ti} = \pi_{0i} + \pi_{1i} \times (\text{Piece1}_{ti}) \\ + \pi_{2i} \times (\text{Piece2}_{ti}) + e_{ti}$$

$$\text{Level 2 model: } \pi_{0i} = \beta_{00} + r_{0i}$$

$$\pi_{1i} = \beta_{10} + r_{1i}$$

$$\pi_{2i} = \beta_{20} + r_{2i}$$

In the Level 1 model, Behavior<sub>*t*</sub><sub>*i*</sub> represents the behavior at session *t* for each mother *i*.  $\pi_{0i}$  is the intercept or model-implied baseline level of behavior.  $\pi_{1i}$  is the slope coefficient for the amount of change in behavior after a one-unit increase in time across the first phase of treatment (Sessions 1–5).  $\pi_{2i}$  is the slope coefficient for the amount of change in behavior after a one-unit increase in time across the second phase of treatment (Sessions 6–10).  $e_{ti}$  is the residual variance of participant *i*'s behavior at time *t* from her predicted growth trajectory. In the Level 2 model, the within-persons intercept,  $\pi_{0i}$ , is estimated by adding  $\beta_{00}$ , which represents the model-implied fixed effect, and  $r_{0i}$ , which represents the deviance for individual *i* from the predicted baseline level of behavior. Next, the within-persons slope of Phase 1,  $\pi_{1i}$ , is estimated by adding  $\beta_{10}$ , the fixed effect change in behavior across

the first piece for mothers in ABC, and  $r_{1i}$ , which is the deviance for individual *i* from the average slope across the first piece. Finally, the within-persons slope of Phase 2,  $\pi_{2i}$ , is estimated by adding  $\beta_{20}$ , the fixed effect change in behavior across the second piece for mothers in ABC, and  $r_{2i}$ , which is the deviance for individual *i* from the average slope across the second piece.

### Missing Data

At study completion, three videos were missing due to data-collection error, and 15 videos were missing because families dropped out before completing the study, resulting in 6.3% missing data. Therefore, full information maximum likelihood was used to account for the missing data, which allows for the use of all available data and provides an unbiased estimate of parameters when data are missing at random (Enders & Bandalos, 2001).

## RESULTS

### Preliminary Analyses

Bivariate correlations varied from 0.13,  $p = .57$ , to  $-0.70$ ,  $p < .01$ , across the 10 sessions between sensitivity and intrusiveness. Individual scatterplots of mothers' sensitivity and intrusiveness were examined to visually investigate patterns of change across time.

### Primary Analyses

**Sensitivity (H1).** As shown in Table 2, the intervention groups did not differ significantly on baseline levels of sensitivity (DEF = 2.32, ABC = 2.19,  $p = .59$ ). As hypothesized, at the end of the 10 intervention sessions, mothers who participated in ABC were significantly more sensitive than were mothers who participated in DEF, and mothers in ABC showed a steeper rate of change in sensitivity than mothers in DEF. More specifically, DEF was estimated to show a 0.26 unit increase in sensitivity,  $\beta_{10}$ , across the 10 sessions, whereas ABC was estimated to show a 0.97 unit increase in sensitivity,  $\beta_{10} + \beta_{11}$ , across the 10 sessions. These rates of increase were significantly different from one another,  $p = .04$ , and represented a medium effect size,  $d = 0.70$ . Therefore, our hypothesis that mothers who participated in ABC would show significant increases in sensitivity when compared to a control condition was supported.

**Intrusiveness (H2).** Again, as shown in Table 2, the intervention groups did not differ significantly on baseline levels of intrusiveness (DEF = 2.84, ABC = 3.14,  $p = .35$ ). As hypothesized, at the end of the 10 sessions, mothers who participated in ABC were less intrusive than were mothers who participated in DEF. In addition, mothers in ABC showed a steeper rate of change in intrusiveness than mothers in DEF. At the end of the 10 intervention sessions, DEF was estimated to show a 0.26 unit decrease in intrusiveness,  $\beta_{10}$ , across the 10 sessions, whereas ABC was estimated to show

**TABLE 2.** Parameter Estimates for Linear Growth Model of Sensitivity and Intrusiveness as a Function of Intervention Group

Fixed Effects	Sensitivity				Intrusiveness			
	Coefficient	SE	t	p	Coefficient	SE	t	p
DEF Baseline $\beta_{00}$	2.32	0.18	12.75	<.001	2.85	0.23	12.21	<.001
ABC Baseline $\beta_{01}$	-0.14	0.25	-0.54	.59	0.30	0.32	0.95	.35
DEF Slope at Session 10 $\beta_{10}$	0.26	0.25	1.07	.30	-0.26	0.29	-0.88	.39
ABC Slope Difference at Session 10 $\beta_{11}$	0.71	0.33	2.13	.04	-0.96	0.40	-2.42	.02
Level 2 Random Effects	SD	Variance	p		SD	Variance	p	
Intercept Variance $r_{0i}$	0.42	0.17	.004		0.56	0.31	.01	
Slope Variance $r_{1i}$	0.19	0.03	.45		0.03	0.00	>.50	

ABC = Attachment and Biobehavioral Catch-up; DEF = Developmental Education for Families.

**TABLE 3.** Piecewise Linear Growth Model of Sensitivity and Intrusiveness and Slope Comparisons for Mothers in ABC

Fixed Effects	Sensitivity				Intrusiveness			
	Coefficient	SE	t	p	Coefficient	SE	t	p
Baseline $\beta_{00}$	1.99	0.19	10.63	<.001	3.37	0.26	13.02	<.001
Piece 1 Slope $\beta_{10}$	0.22	0.06	3.56	.00	-0.27	0.07	-3.71	.003
Piece 2 Slope $\beta_{20}$	0.01	0.05	0.24	.82	-0.02	0.05	-0.40	.70
Slope Comparisons	Estimate	SE	$\chi^2$	p	Estimate	SE	$\chi^2$	p
Piece 1 vs. Piece 2	-.21	0.10	4.57	.03	0.24	0.11	4.66	.03

ABC = Attachment and Biobehavioral Catch-up.

a 1.22 unit decrease in intrusiveness,  $\beta_{10} + \beta_{11}$ , across the 10 sessions. These rates of change were significantly different,  $p = .02$ , and reflected a large effect size,  $d = -0.81$ . Therefore, our hypothesis that ABC would show significant decreases in intrusiveness when compared to a control intervention was supported.

*Piecewise analysis of sensitivity (H3).* Next, piecewise linear growth modeling explored when change occurred for mothers who were randomized into ABC only. The rate of change, or slope, for the first piece of the model was significantly different from zero,  $\beta_{10} = 0.22$ ,  $p < .01$ . The second piece did not show a significant rate of change in sensitivity,  $\beta_{20} = 0.01$ ,  $p = .82$ . To test whether the slopes were significantly different from each other for the first versus the second piece, a chi-square test of differences was conducted using the hypothesis-testing function within HLM. Table 3 shows the results of the piecewise linear growth model and hypothesis test. Mothers showed a steeper increase in sensitivity during the first half of treatment than they did during the second half of treatment.

*Piecewise analysis of intrusiveness (H4).* The rate of change, or slope, for the first piece of the model was significantly different from zero,  $\beta_{10} = -0.26$ ,  $p < .01$ . The second piece did not show a significant rate of change in intrusiveness,  $\beta_{20} = -0.03$ ,  $p = .70$ . To test whether the slopes were significantly different from each other, a chi-square test of differences was conducted using

the hypothesis-testing function within HLM. Table 3 shows results of the piecewise linear growth model and hypothesis test. Mothers showed a steeper decline during the first half of treatment than they did during the second half of treatment.

## DISCUSSION

Interventions that improve parenting quality are especially important for children who have experienced early adversity in order to disrupt negative developmental trajectories. Further, after treatment efficacy has been established, an important next step in understanding how treatments work is investigating when change occurs (Laurenceau et al., 2007). Therefore, the current study was developed to begin to examine how ABC works in a sample of mothers involved in child protective services.

The first aim of the current study was to investigate whether ABC was successful in changing parenting behaviors according to ABC's intervention targets (i.e., sensitivity and intrusiveness). More specifically, we hypothesized that mothers in the ABC intervention would show greater increases in overall sensitivity (H1) and greater decreases in overall intrusiveness (H2) over the course of the 10 sessions than would mothers in a control condition. The second aim of the current study was to investigate possible non-linear trajectories of change by examining the rate and shape of change in sensitivity and intrusiveness across ABC's 10 intervention sessions, as well as by comparing the slopes between each of

the model's pieces to determine when the most change occurred. We hypothesized that sensitivity (H3) and intrusiveness (H4) would change according to a nonlinear, two-piece model, such that the most change would occur early in treatment.

Mothers who were randomized into ABC showed steeper rates of change in sensitivity and intrusiveness by the end of the 10 intervention sessions than did mothers in a control condition. Further, comparisons between the slopes of the two-piece models for both sensitivity and intrusiveness revealed that the first piece had the steeper slope or rate of change in parenting behavior. Thus, results showed support for a nonlinear pattern of change across the 10 intervention sessions of ABC.

Findings from the current study add to the growing evidence that ABC is efficacious in improving parenting behaviors among high-risk parents (Bick & Dozier, 2013). Furthermore, results from the current study are in line with previous research on therapies with children and families that found the most change occurs early in treatment (Eddy, Dishion, & Stoolmiller, 1998). Finally, the current findings echo other researchers' claim that change is not always a linear process (Hayes, Laurenceau et al. 2007) and has implications for treatment providers and developers (Hayes, Hope, Heimberg, & Juster, 2008). Clinicians can use the current findings as a point of reference for when parenting behavior is generally expected to change. If change is not seen within the first few sessions, adjustments to the therapeutic approach can be made if necessary. Although the results of the current study suggest that no significant change occurred during the second half of treatment for sensitivity or intrusiveness, it is unclear whether the full 10 sessions is necessary for sustained treatment effects. This possibility could be tested empirically through an adaptive design (e.g., Lagoa, Bekiroglu, Lanza, & Murphy, 2014).

### ***Strengths, Limitations, and Future Directions***

The current study had several strengths. Of note, the current study used an intensive longitudinal design to collect session-by-session data with 270 coded videos. This not only allowed for an exploration of within-person change across time, but also an opportunity to explore the temporal process by which change in parenting behavior occurred and when change occurred. In addition, both random assignment and the use of a control intervention provide support that the intervention differences at the end of the 10 sessions were due to ABC intervention effects rather than due to common factors between both interventions (i.e., duration, time with an interventionist, home setting, etc.). Furthermore, the current study indicates that ABC was successful in changing parenting behaviors among a very high-risk sample of mothers, highlighting the utility of this home-based intervention. Finally, the current study used an observational coding method of assessing caregiving behavior rather than a self-report measure. This approach allowed for a more objective assessment of change in behavior across each session than does a self-report measure of parenting behaviors and assured the constructs that were being assessed were coded similarly across families.

Although there are several strengths to the current study, there also are important limitations. Even though a fewer number of participants are required to investigate change in outcomes when employing an intensive longitudinal design than when using other types of analyses (Raudenbush & Xiao-Feng, 2001), the current study was still limited by a small sample of mothers ( $N = 24$ ) who participated in an intervention. As a result, the statistical power of the study was limited, and results should be interpreted within the context of the study's limitations. Specifically, the results may be an over- or underestimation of the changes in parenting that may be seen if a larger sample had been used. For example, our effect sizes are somewhat smaller than those reported in a recently published investigation of a community implementation of ABC (Caron, Weston-Lee, Haggerty, & Dozier, 2015), where the effect size for sensitivity was found to be 0.89 and where the effect size for intrusiveness was found to be  $-1.21$ . In addition, the small sample size constrained the ability to determine whether there were differences between treatment completers versus noncompleters and treatment responders versus nonresponders. Finally, in order to gather intensive longitudinal data, observational data were recorded before each intervention session. The timing of data collection may have altered parent performance during the parent-child paradigm. However, parent coaches conducted data collection prior to beginning any form of commenting or reinforcement of specific behaviors. In addition, toys used to assess parent-child interactions were not used during treatment sessions to reduce the possibility of practice effects.

In the future, the use of dismantling studies in combination with an intensive longitudinal design will help clarify what leads to changes in parenting behavior. Furthermore, an adaptive research design will be important in determining the needed number of sessions for sustainable change in parenting behaviors (Lagoa et al., 2014). Specifically, future studies can help elucidate whether the second half of the intervention is necessary for long-term, maintained change in parenting improvements or whether it is necessary for certain types of parents in maintaining change. However, it is too soon to conclude the role that the second half of the intervention has on parenting improvements (e.g., that the second half of the intervention is unnecessary or that the second half helps sustain changes). Additional studies should also investigate characteristics of mothers that might preclude change in parenting behaviors, such as psychopathology, attachment state of mind, and the number of negative life events that occur during intervention implementation. Finally, future studies should investigate whether these findings generalize beyond parents who were found to have an unsubstantiated report of neglect.

### ***Conclusions***

Overall, the current findings add to evidence that ABC is effective in changing parenting quality among high-risk mothers. In addition, the greatest change in parenting behaviors was found to occur within the first few sessions of the intervention and provided preliminary evidence that change within ABC is a nonlinear process.

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