



Quality of infant child care and early infant development in Portuguese childcare centers[☆]

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ABSTRACT

In this study, we examine associations between the quality of teacher–child interactions and infant outcomes during their first months in Portuguese childcare centers. Participants were 90 infants, their mothers and their teachers. A set of multiple regression models were conducted to determine whether classroom quality related to active engagement and non-engagement and to adaptive behavior six months later, controlling for important covariates, namely developmental age, child temperament, mothers' education, and home quality. Results showed that, in higher quality classrooms, infants spent more time actively engaged, less time non-engaged and six months later were rated as having higher levels of adaptive behaviors. Findings provide further evidence for the need to better support teachers in fostering infant active engagement and unfolding capacities as part of high-quality daily experiences in childcare.

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1. Introduction

Many infants now experience early childhood education and care (ECEC) services in their first year, especially in countries like Portugal with high maternal employment rates and limited maternal leave (European Commission/EACEA/Eurydice/Eurostat, 2014). An extensive literature has shown that developmentally adequate learning environments in the early years are related to both short- and long-term outcomes for children; however, we know much less about the effects of center-based ECEC on infants than we do on preschoolers (Burchinal, Magnuson, Powell, & Soliday-Hong, 2015). Because many infants now experience routine non-parental care in their first year and infant development is the precursor to development in preschool and later years, understanding the impact of

infant care on early development is of great interest to parents, teachers and policymakers. This study expands the research on the quality of infant ECEC, by focusing on the associations between childcare quality in infant classrooms and its relation to early indicators of child development, namely infant engagement and adaptive behavior.

1.1. Infant education and care in Portugal

Over the past decades the Portuguese government has made important investments and substantial efforts to increase the coverage rate of ECEC services for children younger than 3 years old and to improve its affordability, not just as a support to working parents, but also as a way to promote child development (European Commission/EACEA/Eurydice/Eurostat, 2014). In fact, Portugal has one of the highest rates of working mothers of children up to age 3 in the European Union (EU), despite the economic recession that began in 2009. In Portugal, subsidized parental leave ranges from 120 to 150 consecutive days (<http://www4.seg-social.pt/subsidio-parental>) and many mothers must return to work before their infants are 6 months old. By the time they are up to 2 years old, 68% of Portuguese children have mothers working full time (Organisation for Economic Co-operation & Development. [OECD], 2017a).

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The available places in formal services (i.e., childcare centers and official daycare mothers) were sufficient to cover 52% of the children in Portugal in 2016, a much higher proportion than the OECD average of approximately 36% (Organisation for Economic Co-operation & Development, [OECD], 2017b). It seems therefore important to know more about the kind of learning experiences that very young children have in these contexts.

1.2. ECEC global quality and its effects

Many studies in both the EU and US have documented the quality of center-based child care programs (see Slot, 2018, for an overview). Global quality has been defined as a multidimensional construct that encompasses both structural features, including teacher qualifications and child:teacher ratios, and process features, such as teacher–child interactions (Burchinal, 2018). Studies of preschool tend to show moderate levels of quality (e.g., Burchinal, Vandergrift, Pianta, & Mashburn, 2010), but in infant/toddler classrooms the quality is generally lower, with studies reporting minimal levels of quality for infant/toddler health and welfare and warm/supportive relationships being observed less than half of the time (Halle, Hair, Burchinal, Anderson, & Zaslow, 2012). Previous studies in Portugal have shown that the global quality of center-based toddler classrooms was homogeneously low, not meeting standards for developmental appropriateness of materials and activities, and not meeting even minimal requirements concerning health and safety (e.g., Pinto, Pessanha, & Aguiar, 2013).

A very extensive literature in the EU and US, both experimental and observational, shows that both global quality and the more specific process features of quality of care matters for young children. Research has provided evidence of short- and long-term effects of developmentally appropriate, high-quality ECEC on preschool children's cognitive, language, social and executive function skills as well as on later school achievement (Burchinal et al., 2015; Vandell, Burchinal, & Pierce, 2016). Some evidence suggests that quality of care also predicts outcomes for infants and toddlers both in the US (e.g., NICHD ECCRN, 2000) and in Portugal (e.g., Pinto et al., 2013), although studies focusing solely on infant classrooms are fewer in number than those focused on toddler (ages 1–2) or preschool years (ages 3–5). Considering the unique characteristics of child development during the first year of life, more studies are needed to inform practitioners and policymakers about how early relations with caregivers may influence developmental transactions and child outcomes (Horm, Norris, Perry, Chazan-Cohen, & Halle, 2016).

1.3. Quality of infant child care

A large component of the quality measures typically used in the studies noted above is the nature of teacher–child interactions; ideally they are warm, meaningful, sensitive and stimulating (Hamre & Pianta, 2001). We focus specifically on this aspect of quality because infants are almost entirely reliant on caregivers to engage with the environment around them and to manage their interactions (Hamre & Pianta, 2001; Jamison, Cabell, LoCasale-Crouch, Hamre, & Pianta, 2014). The adult, whether parent or teacher, plays an important role in infant developmental processes, as the child learns about the world mainly through transactions with adult caregivers (Bronfenbrenner & Morris, 2007) and through play with activities and materials that adults have provided. Within a sociocultural theory perspective, extensive literature has highlighted the adult's role in providing frequent, sensitive, and responsive interactions with children (Bronfenbrenner & Morris, 2007; Vygotsky, 1978).

Extensive research suggests sensitive, responsive caregiving during early childhood has both short- and long-term relations with preschool academic and behavioral outcomes at entry to

primary school and some evidence suggest long-term effects during the school year (Burchinal et al., 2015). The ECEC providers' responsiveness and sensitivity related to school entry skills, which then mediated ECEC quality effects through eighth grade (Hamre & Pianta, 2001), and tenth grade (Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010). Positive teacher–child interactions have been related to better academic achievement, better social competence, higher levels of engagement and task persistence, and higher initiative, participation and cooperation (e.g., Aydoğan, Farran, & Sagsöz, 2015; Hamre & Pianta, 2001). These findings among preschoolers suggest that the association between the quality of early teacher–child interactions and both concurrent and future development, as well as later school performance, can be both positive and persistent (Burchinal et al., 2015).

A few studies have examined the responsiveness and sensitivity of caregivers and overall quality of the child care environment in infant or toddler care. A small study documented higher levels and larger gains in language and social skills who experienced higher quality caregiving for about 90 infants who entered center care during their first year (Burchinal, Roberts, Nabors, & Bryant, 1996). This study measured quality using the Infant Toddler Environment Rating Scale (ITERS; Harms, Cryer, & Clifford, 1990, 2003, 2006) that measures teacher responsiveness and access to age-appropriate activities. A large 10-site study related higher levels of caregiver responsiveness and sensitivity in the child's first years to higher levels of language, cognitive, and social skills at two- to three-years of age (NICHD ECCRN, 2000). They measured caregiver responsiveness with the Observational Record of the Childcare Environment (ORCE; NICHD ECCRN, 2000). The ORCE served as the basis for development of the Infant and Toddler Classroom Assessing Scoring System (CLASS; La Paro, Hamre, & Pianta, 2012; Pianta, La Paro, & Hamre, 2008). The quality of caregiver sensitivity and responsiveness has also been measured through another widely used quality measure, the Arnett Caregiver Interaction Scale (CIS; Arnett, 1989). In a study involving the Early Childhood Longitudinal Study-Birth Cohort, positive associations were found between caregiver sensitivity as measures by Arnett CIS and child outcomes at the age of two (Colwell, Gordon, Fujimoto, Kaestner, & Korenman, 2013). These studies suggest that the quality of teacher–child interaction has positive effects on infant/toddler development, but none of them related ECEC quality to the early development of those skills. Instead they linked infant ECEC quality to toddler and preschool outcomes. Infancy is a period of high plasticity of early development and susceptibility to environmental influences (e.g., Lenroot & Giedd, 2011) and, as such, is a critical time for the establishment of neurobiological foundations of adaptive capacity (Knudsen, Heckman, Cameron, & Shonkoff, 2006). Thus, analyzing the processes that may clarify the effects of infant child care quality on concurrent and future developmental outcomes is of high relevance for infants and toddlers in child care (Phillips & Lowenstein, 2011; Sameroff & Mackenzie, 2003).

Because infancy is a period of rapid growth, measuring infant development and documenting the links between teacher–child interactions and infant development can be challenging. Focusing on children's individual experiences that are embedded in the classroom setting has been stressed as contributing to better understand the relation between measures of childcare quality and child outcomes (Burchinal et al., 2008). Accordingly, and taking a developmental-contextual approach, in this study we conceive infant engagement and adaptive behavior in everyday activities as proximal mechanisms that promote learning (Bronfenbrenner & Morris, 2007; Ladd & Dinella, 2009; McWilliam & Casey, 2008; Williford, Whittaker, Vitiello, & Downer, 2013). Such interactive processes in daily contexts have ecological validity and have been found to be related to learning, well-being, social relations, and academic achievement (e.g., Aydoğan et al., 2015). In this study, we

examine two ecologically valid infant behavior measures — engagement and adaptive behavior. Indeed, both infant engagement and adaptive behavior are developmental outcomes that document person-in-context processes, skills and behaviors closely linked to infant interactions with the objects and people in their environments. Both engagement and adaptive behaviors allow the infant to take in his or her environment and learn to operate on it. They are proximal outcomes of infancy and have been described as the precursor skills for later executive function development (Blair, 2002).

1.4. Infant engagement

Young children learn about the world through play by observing, listening and by active involvement. Engagement is typically considered a multidimensional generalized characteristic that depends on both context and child (Yoder & Symons, 2010), thus depicting the dynamic interactions occurring in natural settings between the characteristics of the individual child (e.g., temperament, gender, cognitive level) (Beijers, Riksen-Walraven, Putnam, de Jong, & de Weerth, 2013) and the social environment (Choe, Olson, & Sameroff, 2013). Positive engagement in activities is characterized by children's enthusiastic, self-directed, and active involvement (Downer, Booren, Lima, Luckner, & Pianta, 2010), occurring often and over an extended period of time (Bronfenbrenner & Morris, 2007). In early childhood, engagement has been commonly defined as the amount of time children spend interacting with their environment in a way that is appropriate for their age, abilities, and surrounding demands (McWilliam & Casey, 2008).

In young children, engagement is documented through observable behaviors including a qualitative dimension that characterizes interactive behaviors, underlying learning processes, and multiple observations are necessary to obtain a stable estimate of engagement (McWilliam & Casey, 2008). Some studies measure several levels of engagement (from more sophisticated to non-engagement) with child attention being placed in the lower levels of engagement or included in unsophisticated engagement together with non-nonengagement (e.g., McWilliam & Casey, 2008). Others (e.g., Kishida, Kemp, & Carter, 2008) believe that attention is a crucial dimension of engagement that provides meaningful learning opportunities via observation. For very young children, as in the present study, attention may be considered a pivotal developmental competence (Colombo, 2001) and a fundamental aspect of engagement with others and with objects, allowing for goal-directed actions (e.g., Mendive, Bornstein, & Sebastián, 2013). In fact, the development of components of engagement such as attention, persistence and active monitoring co-occur with the development of important self-regulatory skills, namely attention flexibility, working memory, and inhibitory control (McClelland & Cameron, 2012). In particular, infant engagement and attention have been hypothesized to support later self-regulation (Blair, 2002; Kochanska, Coy, & Murray, 2001). For example, Kochanska et al. (2001) have reported that children's focused attention at 9 months predicted children's greater effortful control.

Although studies on infant/toddler engagement are scarce, numerous studies on child engagement in preschool, elementary and middle school years have reported associations between child engagement, self-regulation competencies, and achievement (e.g., Eisenberg, Valiente, & Eggum, 2010). For instance, child positive engagement with teachers, peers, and tasks in preschool classrooms was found to be related to compliance/executive function, to gains in emotion regulation and was especially supportive of children's gains in task orientation and reductions in dysregulation (Williford et al., 2013). Previous research on toddler childcare reported moderate to strong associations between

engagement and other concurrent developmental outcomes (e.g., Malone, Stoneman, & Langone, 1994).

Observed engagement for toddlers in ECEC has also been linked to teacher relationship quality, namely positive and affective relations (McWilliam & Casey, 2008). Similar results have been found in toddler classrooms in Portugal, which suggest that in classrooms where teachers were more responsive and contingent, children spent more time actively engaged with peers, adults and objects, and less time non-engaged (Aguiar & McWilliam, 2013). However too little is known about infant engagement with teachers, peers, and tasks in ECEC and its relations with the quality of teacher-child interactions.

1.5. Adaptive behavior

During their first year, infants progress rapidly in several developmental areas with important implications for their performance of the daily activities of life (Taaniila, Murray, Jokelainen, Isohanni, & Rantakallio, 2005). Adaptive behavior during infancy reflects the degree to which the baby is becoming regulated and developing communication, socialization, and motor skills (Sparrow, Cicchetti, & Balla, 2005). These skills emerge and develop rapidly during infancy and whether the infant is on track relative to his/her age within each domain is a reliable predictor of later cognitive development (Breeman, Jaekel, Baumann, Bartmann, & Wolke, 2016).

Adaptive behavior is defined by others' expectations or developmental standards. The adequacy of an individual's adaptive behavior is assessed and reported by others who interact with the child. Indeed, caregiver reports of motor, communication, and autonomy skills have been found to be associated with later developmental grades (Flensburg-Madsen & Mortensen, 2015). These results also show that reports of those who live or interact with infants can be a reliable method of assessment of daily living behaviors.

Only a handful of studies have directly examined adaptive behavior and concurrent cognitive skills in infants and toddlers. The differential magnitudes of these correlations are said to support the assumption that adaptive behavior scales and intelligence and achievement scales measure different areas of functioning (Scattone, Raggio, & May, 2011; Sparrow et al., 2005) but are nevertheless correlated (Rosenbaum, Saigal, Szatmari, & Hout, 1995). Indeed, although the capacity is necessary for the performance of daily activities, the adaptive behavior of an individual is considered inappropriate if this capacity is not demonstrated when needed (Sparrow et al., 2005). Thus, one important aspect of adaptive behavior is that it is defined by the typical performance and not by capacity, and therefore is contextually and culturally embedded.

In a study that examined daily functioning in toddler classrooms, results showed associations between children's adaptive behavior, developmental age and levels of children's individual engagement as observed in the classrooms, indicating that children obtaining higher scores on adaptive behavior had higher scores on a standardized developmental test and spent more time in higher levels of engagement and less time non-engaged in ECEC classrooms (Pinto, Barros, Aguiar, Pessanha, & Bairrão, 2006). Such associations may indicate a relation of both engagement and adaptive behaviors to children's competence.

Adaptive behavior has also been shown to be related to quality of care in toddlers' classrooms. Pessanha, Aguiar, and Bairrão, (2007) found positive associations of small magnitude between global classroom quality and toddlers' adaptive behavior. Pinto et al. (2013) reported small effects of teacher-child interactions on toddlers' communication scores on the Vineland, even though classrooms were of homogeneously low quality.

Despite the importance of all children developing daily living competences, research has mostly focused on infant adaptive

behaviors of children at risk or with a disability (e.g., Vohr et al., 2003). The present study expands previous literature by analyzing concurrent associations between the infant classroom quality and the adaptive behavior of typically developing infants.

In summary, both infant engagement and adaptive behavior are developmental outcomes that document person-in-context processes, skills and behaviors closely linked to the infant's interactions with objects and people in their environments. The quality and quantity of interactions with the child care teacher, as well as parents and other adults in the home environment, provide the basis for developing selective attention and engagement which, in turn, underlie the development of behaviors that are necessary for success in school and later life, namely self-regulation and executive functioning (Blair, 2002).

1.6. The current study

In the present study, we examine the associations between infant engagement and adaptive behavior and the responsiveness and sensitivity of caregivers in infant classrooms. In this study, we use a set of different measures – the CLASS Infant version, the Arnett CIS and a subset of the ITERS-R – to document the quality of sensitive and stimulating interactions. We chose to use all three of these measures because each looks at the quality of adult-infant interactions through a somewhat different lens and we wanted the most comprehensive quality assessment as could be obtained. Whereas ITERS-R focuses on more broad general features of the caregiver responsiveness, supervision and safety practices, the Arnett CIS puts an emphasis on the emotional tone of the caregiver while interacting with children. The CLASS, which also focuses on the emotional level of teacher-child interactions, it adds greater detail on the level of cognitive and linguistic stimulating interactions. Therefore, the use of the three measures contributes to a nuanced view of process quality. In addition, there have been numerous calls for the importance of using and combining different measures of quality, so that a more sophisticated understanding of quality can be obtained (Burchinal & Cryer, 2003; Burchinal et al., 2010; Burchinal, 2018).

Based on previous evidence, we hypothesized that infant care quality would be related to infant engagement and adaptive behavior. There has been little empirical work dedicated specifically to teachers' interactions in infant classrooms, therefore this may be among the first studies to directly examine the association between the quality of interactions in infant classrooms and infant outcomes.

2. Method

2.1. Participants

Participants were 90 infants and their families (mothers) and child caregivers from 90 infant childcare classrooms in the greater metropolitan area of Porto, Portugal. They were part of a broader research project focusing on infants' transition to child care. Recruitment first involved selecting centers that served infants. Of the 418 centers in the greater metropolitan area, registered at the Ministry of Solidarity, Employment and Social Security website, 232 had an infant classroom, defined as classrooms for children up to the acquisition of walking (Portaria n° 262/2011, August 31st). These centers were contacted in a random order, and the first 90 centers that both agreed to participate and (a) had at least one family with a 4–9-month old infant (b) registered to start attending the child care in the next few months were recruited. In most centers, only one infant met the criteria to participate; if more than one, researchers randomly selected the family to contact. Only one

classroom per center was selected to participate. The recruitment period was September 2013 to February 2014. Informed consents were obtained from the parents and then from the child's teacher. Infants in this study (45 female; 45 male) were between 3 and 9 months ($M=4.63$, $SD=1.40$) at recruitment and between 4 and 10 months old ($M=6.00$, $SD=1.34$) when they entered childcare services. The Portuguese National Data Protection Authority approved all measures as well as data collection and confidentiality procedures.

The classrooms of the selected infants typically had about 6 infants enrolled ($M=6.38$, $SD=2.34$; range = 1–12) and 1–3 caregivers ($M=2.00$, $SD=0.60$), with a child:adult ratio that ranged from 1:1 to 8:1 ($M=3.38$, $SD=1.49$). On average, the youngest infant in the classrooms was 4.99 months and the oldest was 10.79 months. The teachers were all female and their age ranged between 20 and 64 years old ($M=42.53$, $SD=9.97$). Their mean level of education was 11.10 years ($SD=3.64$), ranging from a basic level of education (5.6% had only four years of formal education) to a university degree level (22.2% had 15 or more years of formal education). They had worked in childcare centers for 1 month to 37 years ($M=8.36$, $SD=6.50$).

The infants' mothers were, on average, 30 years old ($SD=3.55$). Their level of education averaged 14.42 years ($SD=3.58$); 59% of the mothers had a university level of education, and only 3% had less than 9 years of formal education. Families' average monthly income was 1622.40€ ($SD=670.77$).

2.2. Procedures

This study involved three assessment periods. In the first assessment, a home visit was conducted before infants entered childcare to measure baseline family and child characteristics. Home visits lasted, on average, two hours and typically involved the mothers. Trained observers assessed home quality based and interviewed mothers to collect information about socio-demographic characteristics. Mothers completed the questionnaire on child temperament. Child development was assessed by the observer during this visit.

The second set of assessments were conducted in the childcare center during infants' first month in child care. During two full mornings, trained observers assessed the quality of infant experience in child care and observed infant engagement. Regarding infant engagement, three observation cycles of 10 min each were conducted in each morning during play activities. Observers were instructed not to observe children during meal time, diaper change or when infants were upset (e.g., observers waited for a crying infant to calm down) or about to take a nap. They also obtained data from the teacher on classroom structural characteristic and teacher education and experience.

The third assessment took place approximately six months after infants entered the center. Teachers reported on infants' adaptive behavior.

2.3. Measures

Time 1. The measures used during the home visit prior to the infant entrance into child care are described below.

The Home Observation for Measurement of the Environment Inventory (HOME; Caldwell & Bradley, 1984). The HOME was used to assess home environment quality (Caldwell & Bradley, 1984). This measure focuses on family organization, routines, family involvement with extended family, and use of community resources that affect children. Globally, it provides information on the quality and quantity of support and stimulation that children are receiving at their homes. We used the HOME Infant-Toddler version, composed of 45 items organized in six subscales:

Responsiveness, Acceptance, Organization, Play/learning Materials, Involvement, and Variety of Experience. Each item is scored 0 or 1 (presence or absence), based both on a semi-structured interview and on direct observation of parent behavior. A HOME Global Quality score was computed, in the present study, by combining all the items from the scale. Previous studies provide evidence for the HOME measure's adequacy, reliability and validity, including in Portugal (e.g., Caldwell & Bradley, 1984; Cruz et al., 2011; Totsika & Sylva, 2004). Original studies with the scale report moderate to strong internal consistency (.44–.89). Cronbach's alpha in the present study was .69. Observers had previous training in assessing the home environment from their master degrees and, prior to data collection, they participated in a training session involving live coding with the HOME Infant-Toddler version.

Family Questionnaire. This questionnaire was designed to collect information on family structural characteristics, such as family income, family size, parents' level of education, age and employment status.

Infant Behavior Questionnaire (IBQ; Rothbart, 1981). This is a broadly used measure for assessing infants' temperament and there is wide evidence for its adequacy, reliability and validity (e.g., Clark, Hyde, Essex, & Klein, 1997; Klein, Putnam, & Linhares, 2009; Rothbart, 1981; Sung, Beijers, Gartstein, de Weerth, & Putnam, 2015). The IBQ-R is organized in the following 14 dimensions, rated on a 7-point scale: Activity Level, Distress to Limitations, Approach, Fear, Duration of Orienting, Smiling and Laughter, Vocal Reactivity, Sadness, Perceptual Sensitivity, High Intensity Pleasure, Low Intensity Pleasure, Cuddliness, Soothability, and Falling Reactivity. The IBQ authors used a Principal Axis analysis to produce three broad factors (Gartstein & Rothbart, 2003). Good reliability was also found in the present study for the three factors: Surgency/Extraversion ($\alpha = .82$), Negative Affectivity ($\alpha = .89$), and Orienting/Regulation ($\alpha = .81$). The present study analyzed data only from the Negative Affectivity dimension.

Griffiths Mental Development Scales (Griffiths, 2007, adapted to Portuguese by Ferreira, Carvalhão, Gil, Ulrich, & Fernandes, 1996). This measure was used to assess children's development. This is a differential measure of child development for children between birth and 2 years of age that provides an individual profile of the child performance in a standardized assessment situation. It is organized in five subscales, namely: (a) Locomotor Development, (b) Personal-social Development, (c) Language Development, (d) Eye and Hand Co-ordination, and (e) Performance. Three types of results can be obtained with this measure: global child developmental age, global developmental coefficient, and developmental age and coefficient for each subscale. This is a widely known and used measure of infant/toddler development with adequate reliability and validity extensively documented (e.g., Griffiths, 1996). In the present study, the global developmental age scores, presented in days, are analyzed. Observers had previous training in this measure from their master degrees and, prior to data collection, they participated in a training session involving live coding with infants.

Time 2. The measures collected during the classroom observations during the infants' first month at the center are described below.

The Individual Child Engagement Record – Revised (ICER-R; Kishida et al., 2008). The ICER-R was designed to observe individual child engagement using a momentary time-sampling system. This measure consists of a direct observation for periods of 10 min using 10-second time sampling to code four mutually exclusive types of engagement: Active Engagement (the child actively participates in the activity by interacting with the learning environment appropriately by manipulating materials or vocalizing), Passive Engagement (the child interacts with the environment without manipulation or vocalization; e.g., observes the teacher or the book during story

time, watches other children eating), Active Non-engagement (the child interacts with the environment in an inappropriate manner), and Passive Non-engagement (the child does not interact with the environment and does not do what is expected of him/her during the activity). A score for each type of engagement is computed by calculating the percentage of its occurrence across the 6 observation cycles. Concurrent validity with a measure of child engagement and inter-observer reliability were previously established (Horm et al., 2016). In this study, all observers attended training sessions prior to data collection to become reliable on the measure. Training included theoretical/practical sessions about the measure, videos scoring and group discussion, and live observation in child care. During training, each observer achieved at least 80% of exact agreement with a master coder. During data collection inter-observer reliability was also assessed on 21% of the observations. Exact agreement with the master coder varied between 92% and 99% for type of engagement, with weighted kappa ranging between .47 (for the Passive Engagement) and .81 (for the Active Engagement). In the present study, each infant was observed for 6 cycles of 10 min each, across 2 different mornings at childcare (3 in one morning, and 3 in the other). Observers were instructed to observe the child during play activities, and not during meals, diaper change, or when the child was sleepy (e.g., near the nap time). We selected active engagement and active non-engagement, for the present study, based on previous research reporting no associations between passive engagement and young children's concurrent developmental outcomes (Kishida et al., 2008).

Teacher–Infant Interaction Quality. The quality of infant experience in child care was observed in each classroom during two full mornings to score the three measures described below. Observers were trained to reliability before data collection, scoring and discussing training videos, and making live observations in classrooms with a master coder (for more details see Barros et al., 2016). Reliability was monitored during data collection. The ITTERS-R was scored based on a 3–4 h observation, followed by an interview of the lead teacher. On another morning within a 3-day time frame, a different observer scored the CLASS-Infant and the CIS.

Infant/Toddler Environment Rating Scale – Revised (ITERS-R; Harms et al., 2006). The ITERS-R captures the overall quality of infant childcare classrooms. It includes 39 items, scored in a 7-point scale, and organized under seven conceptually defined subscales: Space and Furnishings, Personal Care Routines, Listening and Talking, Activities, Interaction, Program Structure, and Parents and Staff. This study used the Portuguese translation of the ITERS-R (Harms et al., 2012). Inter-rater reliability was obtained in 25.6% of data collection observations. Exact agreement averaged 89.53%, within-one point agreement averaged 92.24%, and weighted kappa averaged 0.73. Considering the results of a previous factor analyses (Barros et al., 2016), only one factor – ITERS-R Interactions and Supervision – is included in the present study, given our interest in looking at infant teacher positive interactions and teacher sensitivity. This factor comprises 8 items including features related to caregivers' responsiveness and sensitivity, support for child language, and use of positive discipline and active supervision ($\alpha = .80$).

Caregiver Interaction Scale (CIS; Arnett, 1989). This measure assesses the quality of interactions between children and their caregivers in educational settings. It is a judgment-based observation measure coded on a 4-point-scale. It includes 26 items organized into the following dimensions: Sensitivity, Harshness, Detachment, and Permissiveness (Arnett, 1989). National and international studies report adequate validity and reliability (Colwell et al., 2013). Inter-rater reliability was calculated on 25.6% of observations in the field. Exact agreement averaged 68.24%, within-one point agreement averaged 99.02%, and weighted kappa averaged 0.42. Based on the results of a previous factor analyses (see Barros et al., 2016), the present study uses a variable comprised of 21 out of the total 26

items of the scale ($\alpha = .91$). This variable is referred to as CIS Total mean score.

Classroom Assessment Scoring System – Infant (CLASS-Infant; Hamre, La Paro, Pianta, & LoCasale-Crouch, 2014). The CLASS-Infant is an observational measure that intends to assess the quality of interactions between caregivers and infants in childcare settings. It was designed based on developmental theory and recommended early childcare practices, and is composed of four dimensions: Relational Climate, Teacher Sensitivity, Facilitated Exploration and Early Language Support. These four dimensions can be organized in a single construct, which was used in the present study ($\alpha = .90$). Inter-rater reliability was calculated for 25.6% of the CLASS-Infant observations. Exact agreement averaged 65.22%, within-one point agreement averaged 99.18%, and weighted kappa averaged 0.70.

Preliminary analyses examined the extent to which the three observational quality measures – the CLASS-Infant, CIS Total mean score, and ITES-R Interactions and Supervision factor score – could represent a single construct of the levels of warmth, sensitivity, and stimulating teacher–child interactions in infant classrooms. Prior studies have demonstrated the utility of combining classroom quality measures when a single dimension is indicated (e.g., Barros et al., 2016; Burchinal & Cryer, 2003; Peisner-Feinberg et al., 2001). Combining the measures into a single score allowed us to get a comprehensive interaction measure while simultaneously getting a more precise and accurate picture across two-days observation. Specifically, several confirmatory factor analyses were performed, first testing the factor structure of the three measures, CLASS-Infant, CIS and ITES-R (see Barros et al., 2016, for details). Then, we examined the extent to which interaction quality could be conceptualized as an overall, unitary construct across measures, testing a set of models, including one with all indicators of the three measures loading on a single common factor. The factor analyses indicated that a single dimension for interaction quality provided the best fit, $\chi^2(55) = 94.049$, $p < .001$, RMSEA = .089; SRMR = .057; CFI = .952 (see Barros et al., 2016, for details). Thus, the CLASS-Infant, CIS Total mean score, and ITES-R Interactions and Supervision factor score were combined to create a composite variable of process. The CIS scores were multiplied by 7/4 to put them in the same metric as the other two scales. Then the mean of the three scores was computed. The internal consistency of this composite was adequate ($\alpha = .78$).

Time 3. About six months after the infants were enrolled in the childcare center, teachers were asked to rate the infants' social and psychological adjustment with the Vineland Adaptive Behavior Scale.

Vineland Adaptive Behavior Scale (VABS; Sparrow et al., 2005) is a widely used and validated measure (e.g., Floyd et al., 2015) that aims to assess individuals' personal and social independence, from birth to adulthood (Sparrow et al., 2005). In this study, VABS was used to determine the degree to which the infant was learning to regulate and acquire motor, social and cognitive skills as expected given their age. This measure does not require a direct assessment of the child, although the person who answers the scale must be familiar with the child's behavior. The authors of the scale have defined "adaptive behavior" as the performance of the necessary daily activities for personal and social self-sufficiency (Sparrow et al., 2005). VABS has been used previously in Portugal (Pinto et al., 2013), supporting our decision to use it in this study. The VABS is composed of four main dimensions: communication (e.g., smile to the caregiver; seems to understand "no"), daily life skills (e.g., open the mouth when food is presented, feeds himself/herself with a spoon), socialization (e.g., reacts to the caregiver voice; shows interest in new persons or objects) and motor skills (e.g., holds the head up for at least 15 s without support (when in caregiver's lap, sits without support). It also includes one version for parents and one for teachers. In this study, we used the teacher version of the

Table 1

Descriptive statistics for child and family characteristics, classroom quality, and child outcomes.

	Scale	M	SD	Min	Max
Child & family characteristics					
Developmental age (days)		142.99	46.79	53	285
Negative affect	1–7	3.37	.82	1.55	5.98
Maternal education		14.39	3.59	4.00	22.00
Home quality	1–42	32.82	4.16	23.00	42.00
Teacher–infant interaction quality	1–7	4.26	.67	2.46	5.94
Infant outcomes					
Active engagement – 1 mo.	1–100	43.63	16.30	7.50	77.50
Non-engagement – 1 mo.	1–100	19.96	10.97	.42	53.33
Adaptive behavior – 6 mo.		77.67	11.40	54	105

Note: Developmental age, as assessed by the Griffiths; negative affect, as assessed by IBQ; maternal education (years of education); home quality, as assessed by the HOME; teacher–infant interaction quality, a composite of ITES-R, CLASS, and CIS; active engagement and non-engagement, as assessed by ICER-R.

scale, including all items of the different dimensions from 0 to 24 months old. Each item is rated 2 (behavior is usually or habitually performed), 1 (sometimes or partly performed), or 0 (never performed) (Sparrow et al., 2005). Item rates are summed to obtain a global score. Regarding the scale metric characteristics, each scale domain was correlated with the global score obtained with the measure. Internal consistency was also analyzed both for the scale global score and for the individual domains. Results showed an adequate consistency, with the Guttman Split-Half coefficient of .85.

2.4. Data analysis

Two sets of analyses were conducted. First, descriptive analyses were conducted by computing means, standard deviations, and correlations for the classroom quality and child outcome measures. Second, hierarchical multiple regressions were conducted to determine whether classroom quality scores were positively associated with child outcomes in classrooms, controlling for several possible confounds. The covariates in these analyses included developmental age, child temperament (negative affectivity), mother's education, and HOME total score. Effect sizes were computed to represent the increase on the outcome measure in standard deviation units with an increase of one standard deviation in classroom process quality (NICHD ECCRN & Duncan, 2003). Complete data were available for all children for all variables, with exception of maternal education; maternal education had less than 2% missing data.

3. Results

3.1. Descriptive analyses

Table 1 provides descriptive statistics for family, child, and classroom measures. Table 2 provides correlations among all variables. On average, maternal education was 14 years and the quality of the home environment was moderate to high. Children's developmental age was 143 days, and mothers reported children displaying moderate levels of negative affect. In the classroom, children were observed to be actively engaged nearly 44% of the time and 20% of the time non-engaged (see Table 1). However, the standard deviations and ranges indicate considerable variability. Cognitive skills as indexed by developmental age were moderately and positively associated with the infant's adaptive behavior and active engagement, while maternal ratings of infant temperament (i.e., negative affectivity) were correlated with active non-engagement. Maternal education and home quality were modestly correlated. Higher

Table 2
Correlations between child and family characteristics, classroom quality, and child outcomes.

	1	2	3	4	5	6	7
1. Developmental age (days)							
2. Negative affect	.04						
3. Maternal education	-.12	-.09					
4. Home quality	.14	-.13	.20 [†]				
5. Teacher–infant interaction quality	-.03	.00	-.12	-.06			
6. Active engagement – 1 mo.	.49**	-.05	-.14	-.05	.19 [†]		
7. Non-engagement – 1 mo.	-.11	.24 [†]	.04	-.13	-.28**	-.45**	
8. Adaptive behavior – 6 mo.	.40**	.07	.01	.08	.19 [†]	.34 [†]	-.20 [†]

[†] $p < .10$.

* $p < .05$.

** $p < .01$.

Table 3
Summary of regression models predicting infant outcomes from classroom quality.

	Observed active engagement – 1 mo.			Observed non-engagement – 1 mo.			Teacher rated adaptive behavior – 6 mo.		
	B	SE	β	B	B	B	B	SE	B
Child & family characteristics									
Developmental age	.18	.03	.51**	-.03	.02	-.11	.10	.02	.41**
Negative affect	-2.41	1.82	-.12	3.07	1.37	.23 [†]	.74	1.37	.05
Maternal education	-.23	.43	-.05	.10	.32	.02	.25	.32	.08
Home quality	-.44	.37	-.11	-.27	.28	-.10	.08	.28	.03
Teacher–infant interaction quality	4.68	2.21	.20 [†]	-4.71	1.67	-.29 [†]	3.73	1.68	.20*

* $p < .05$.

** $p < .01$.

classroom quality was modestly related to more positive child outcomes and significantly related to lower levels of non-engagement.

3.2. Regression analyses

Next, we computed a set of models testing whether classroom interaction quality contributed to adaptive behavior, active engagement and non-engagement, controlling for important covariates. The summary of the results from the regression models is presented in Table 3. After accounting for developmental age and other covariates, higher levels of classroom process quality predicted higher levels of adaptive behavior, $B = .20$, $p < .05$, $\Delta R^2 = 5\%$, more time in active engagement, $B = .20$, $p < .05$, $\Delta R^2 = 4\%$, and less time non-engaged, $B = -.29$, $p < .05$, $\Delta R^2 = 8\%$, although the magnitude of the effects was modest. In addition, developmental age was positively associated with adaptive behavior and active engagement, respectively, $\beta = .41$, $p < .01$ and $\beta = .51$, $p < .01$. Children with higher levels of negative affect spent significantly more time non-engaged, $\beta = .23$, $p < .05$.

4. Discussion

The purpose of this study was to analyze the associations between quality of teacher–child interactions and infant outcomes during their first month in out-of-home education and care. The assessment of infant child care quality included a composite measure with indicators from three widely used measures – the teacher responsiveness factor from the ITERS-R, the CIS, and the CLASS-Infant. All children were observed before and during enrollment in childcare, on their first year of life; infant outcomes included active engagement, active non-engagement and adaptive behavior.

Results showed that after one month in child care, infants spent more time engaged when they experienced higher quality teacher–child interactions, and 6 months later were rated by their teachers as having higher levels of adaptive behaviors. Relevant developmental theories provide a guiding framework to explore how psychological processes are developed through interactions with adults, peers and the learning context (Bronfenbrenner & Morris,

2007; Vygotsky, 1978). At this young age, infants are entirely dependent on their caregivers, so it is important that adults – parents as well as childcare providers – interact with them in this critical window in time in ways that facilitate the emerging skills. In fact, development and learning do not only occur through access to high quality learning materials, but it is the design of activities in the context of a meaningful social transaction between the infant and his or her teachers and/or peers that is necessary.

Our findings are consistent with prior studies of older children showing that high-quality teacher–child interactions are important for child development, even when a robust set of covariates are accounted for. The results extend prior work suggesting that warm, meaningful, responsive and stimulating interactions contribute to infant engagement and everyday competence. Interactions that are responsive, that help infants to explore and learn about the world, that expand and extend children's language experiences seem to foster greater levels of engagement and everyday life competences. An environment with positive affect and emotional exchange, responsive caregiving, and sensitive interactions allow the young child to obtain information on themselves and their world in a context they rely on (Jamison et al., 2014).

As Vygotsky's theory emphasizes, children do not engage in activities in isolation of their social relationships. Systematically observing how a child interacts with peers, teachers, and activities in the childcare classrooms has the potential to inform teachers how to establish responsive and warm interactions based on the child interests, in order to expand such interests and thus promote engagement and adaptive competences in the early education environment. Adult–infant interactions have the potential to promote meaningful and active learning about the environment (Jamison et al., 2014), and also to provide a safe emotional climate where children are able to explore their environment and interact with other children (e.g., Sroufe, 2000).

Following assumptions of the ecological and transactional perspectives of human development, we focused on infant behavioral outcomes with ecological validity by measuring processes and interactions being established between the infants and their life contexts. The engagement measure we used proved to be an

efficient way to assess infant engagement and non-engagement, compared to other measures that are more time-consuming in observers' training and in data collection time (Kishida et al., 2008).

The results from this study provide further support for the theoretical focus on the importance of the quality of interactions between infants and their caregivers. As theorized, more sensitive and responsive caregiving in infant care was related to both more active engagement concurrently and age-appropriate developmental functioning six months later. It is possible these results reflect importance of caregiver interactions in developing goal-directed actions, such as attention, persistence and active monitoring among infants, important competences for children's subsequent learning and development (Kochanska et al., 2001; Ladd & Dinella, 2009).

Because engagement encompasses such relevant aspects of infant development and reflects the competence of the child to participate appropriately in natural environments, results of the present study are promising. Supporting the development of such competencies in early education settings by promoting infant engagement through adequate interactions seems to be of crucial importance for the development of self-regulation mechanisms (McClelland & Cameron, 2012), and executive function abilities (Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000). Previous research highlights the relevance of the child's interest and engagement in an activity as strengthening inhibitory and attentional control during the activity (Pessoa, 2009).

Engaging in meaningful activities provides the basis for engaging in more complex behavior. A child who becomes more competent in certain behaviors will develop a sense of mastery and will show interest in engaging in more complex behavior, such as problem solving and persistence (Almqvist, Uys, & Sandberg, 2007).

In addition to infant engagement, this study also related teacher-infant interactions to infant adaptive behavior. As Bornstein (2014) has noted, infants have recently made one of life's most major adaptations (from womb to world), so perhaps they are uniquely qualified to continue adjusting. But they obviously need support. Communication, socialization, and motor skills are infant behaviors considered to be milestones for healthy developmental trajectories (e.g., Flensburg-Madsen & Mortensen, 2015). As our results show, infants' typical daily performance in a norm-referenced description of functional outcomes as the VABS, is associated with teacher-infant interactions in the ECEC setting. This result suggests that by focusing on such infant outcomes, we may be in a better position to encourage teachers to create opportunities through planning and adequate interactions that will promote the unfolding of infants' capacities in observable daily performance. These capacities are seen as milestones for future development (Breeman et al., 2016).

Infancy is a sensitive period in the neurobiological foundations of development. Implications of this study's findings are the relevance of monitoring individual child engagement and adaptive behavior and of encouraging infant teachers to provide sensitive and warm interactions, facilitate infant's exploration and support their early language, thus promoting infant behaviors considered to be milestones for healthy developmental trajectories,

4.1. Limitations

Some limitations should be acknowledged when interpreting our findings. This study cannot establish causal relations between the quality of interactions with teachers and infants' early development. Important child and family characteristics, collected prior to entry to child care, were included as covariates, but this does not eliminate such concerns. It is important to note that, surprisingly, family covariates were not associated with child outcomes. This lack of associations may be due to both outcomes being measured in the ECEC context, not at home. It may also have resulted from the restricted variance of mother education of this sample,

considering that a large percentage of the mothers had a university degree. Even though the levels of mother education are considerably higher compared to the general population for this age range, it is important to stress that data from the OECD Family Dataset shows that mothers with higher levels of education are considerably more likely to use ECEC for children under two, compared to mothers with low educational levels (Organisation for Economic Co-operation & Development. [OECD], 2017b).

It should be acknowledged that, because of the inclusion criteria and the research project goal of examining infant transition, only one infant per classroom was part of this study, preventing a broader generalization of the results. It is also possible that observing infants one month after transitioning to center care might reflect children's continuing distress to being in a new environment, although a prior study indicated that transition behaviors had largely ceased within a month for infants (Cryer et al., 2005). It is reassuring that teacher ratings after the child had been in the setting for six months yielded similar findings.

Responses on the Vineland may be subject to inaccurate reporting by the caregiver, but also reflect what caregivers value as relevant to children's competence. However, by focusing on the infant's typical performance in ECEC through teachers' expectations of developmental standards (Sparrow et al., 2005), rather than results on standardized tests, we aimed to underline that children's capacities may be a necessary but not sufficient condition for their performance to be demonstrated in the ECEC setting. Thus, we favor assessment in context. Moreover, in a previous study of toddlers in child care programs, we have shown that their adaptive behavior was positively related to scores on a standardized developmental test (Pinto et al., 2006). It is worth mentioning that even though inter-rater reliability was assessed for all observational quality measures, inter-rater reliability was not checked for the HOME, although this measure has been shown adequate reliability in prior studies.

In summary, this study suggests that quality of the interactions between infants and their teachers may play an important role in developing very early attentional and behavioral skills, skills that have been linked to later cognitive, academic, and executive function outcomes. Given the relatively low quality observed in most studies of infant center care, this study provides further evidence that researchers, parents, and policymakers should focus on the quality of infant care.

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