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Variations of Quality of Teacher–infant Interactions Across Play and Care Routine Activities

Joana Cadima^a, Sílvia Barros^b, Donna M. Bryant^c, Carla Peixoto^{b,d}, Vera Coelho^a, and Manuela Pessanha^b

^aFaculty of Psychology and Educational Sciences, University of Porto; ^bPolytechnic Institute of Porto, School of Education; ^cFrank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill; ^dDepartment of Social and Behavioural Sciences, University Institute of Maia

ABSTRACT

This study examined the extent to which the quality of teacher–infant interactions varies across play and routine care activities. In addition, the effects of the quantity of adult involvement in the quality of teacher–infant interactions were investigated. Participants were teachers and infants from 90 infant classrooms in Portugal. Classrooms had, on average, six infants enrolled ($M = 6.38$, $SD = 2.34$), with the number of adults ranging from 1 to 3 ($M = 2.00$, $SD = 0.60$). Classrooms were observed by trained observers using the Classroom Assessment Scoring System–Infant (CLASS–Infant). *Research Findings:* Multilevel models showed that interaction quality varied as a function of type of activity. The quality of interactions of all CLASS domains was lower in routine care activities compared to play activities. Findings further showed that adult involvement was positively associated with all CLASS domains. In addition, after adding adult involvement to the models, differences between play and routine care activities were no longer statistically significant for most CLASS domains. *Practice or Policy:* Findings suggest the importance of considering the context of the activity and the levels of adult involvement when assessing and improving the quality of teacher–infant interactions.

It is widely acknowledged that young children develop key social, emotional, and cognitive competences through interactions with adults, peers and learning activities in early childhood education and care (ECEC) settings (Bratsch-Hines et al., 2020; Broekhuizen et al., 2018; Choi et al., 2019; Howes et al., 2008; NICHD Early Child Care Research Network, 1998, 2006; Pinto et al., 2019). During the very first years of life, interactions with teachers are considered extremely important (Chazan-Cohen et al., 2017; Erekly-Stevens et al., 2018; Shonkoff & Phillips, 2000; Zero To Three, 2010). Infancy is a period marked by rapid growth in children's skills, and early experiences are seen as having a critical role in supporting them (Shonkoff & Phillips, 2000; Trevarthen & Delafield-Butt, 2017; Valloton, 2009; White et al., 2015). Increasingly, infants are attending full-time ECEC programs and teachers are expected to be responsive and sensitive to their needs and interests consistently, but the extent to which the quality of teacher–infant interactions is constant throughout the day remains poorly understood. It is possible that the quality of teacher–infant interactions varies as a function of classroom features, such as type of activity. Infants' time is typically structured around routine and play activities and this structure is likely to play a role in the type of opportunities created for high-quality interactions (Bussey & Hill, 2017; Loizou & Recchia, 2018; Sims et al., 2018). In addition, adults can display varying levels of involvement, depending on the activity or time of day (Alvim Gonçalves et al.,

2020; Kontos & Keyes, 1999). In this study, we examined whether routine/care and free play are linked to different quality levels of teacher-child interactions, and the links between interaction quality and levels of adult involvement.

Process and Structural Quality

Decades of research have documented the importance of ECEC quality (Bratsch-Hines et al., 2020; Broekhuizen et al., 2018; Vandell et al., 2010). Research has fostered fruitful discussions about definitions of quality and the identification of quality dimensions, such as structural quality vs. process quality (Bryant et al., 2011). Process quality, comprising the dynamic features of children's interactions with adults, peers, and materials, has been shown to be foundational for child development, learning and well-being (OECD, 2018).

Considerable observational evidence has linked process quality to infant-toddler development (Bratsch-Hines et al., 2020; Broekhuizen et al., 2018; Burchinal et al., 1996; Choi et al., 2019; NICHD Early Child Care Research Network, 1998, 2006; Pinto et al., 2019). Studies have shown the crucial role of sensitive, responsive and stimulating relationships for child development and learning (Hamre et al., 2014; Jamison et al., 2014; Pinto et al., 2019). Rich learning opportunities combined with reciprocal and warm relationships positively contribute to infant and toddlers' learning. They are paramount in definitions of process quality (Broekhuizen et al., 2018; Burchinal et al., 1996; Choi et al., 2019; Ruzek et al., 2014). From an attachment theory perspective, responsive relationships have the potential to create a secure environment where infants and toddlers may actively explore and develop their autonomy (Ereky-Stevens et al., 2018; Hamre et al., 2014; Jamison et al., 2014; Ruprecht et al., 2016). Similarly, teachers' active attempts to expand language experiences and extend infant and toddler understanding about their environment through reciprocal and encouraging exchanges have been considered crucial for high-quality interactions (L. G. Gillespie & Greenberg, 2017; Jamison et al., 2014; Pauker et al., 2018; Williams et al., 2010). Responsive interactions, together with suggestions, gentle feedback, and adjusting materials and the environment to facilitate learning opportunities are at the core of current definitions of process quality (Chazan-Cohen et al., 2017; OECD, 2018).

Many authors argue that child-adult interactions must be persistently assured across contexts and become gradually more complex to maximize their benefits (e.g., Bronfenbrenner & Morris, 2006). However, some structural features appear to make it more difficult to assure high-quality interactions and their stability over time and activity context. Features, such as unfavorable infant:adult ratios or large group sizes have been shown to contribute to lower-quality interactions between adults and infants/toddlers (Degotardi et al., 2018; Diebold & Perren, 2019). On the other hand, higher teacher qualifications tend to be associated with higher-quality interactions (Barros et al., 2018).

Even though process quality is important for the 0–6 full age range, several authors contend that working with under 2-year-olds is highly individualized and specialized. It thus requires a different emphasis in terms of how infant learning and development are viewed (Dalli et al., 2011; Recchia & Shin, 2012). This is due to the complex and unique needs of infants and to the kind of physical and emotional care that they require (Dalli et al., 2011).

Infant Development and Communication Styles

Robust evidence has shown that infants are active and sophisticated participants in the social processes of learning and development (Trevvarthen & Delafield-Butt, 2017). Current developmental research has shed light on infants' propensity to actively engage in emotionally satisfying relationships and communication as they explore, inquire and play with others (Dalli et al., 2011; White et al., 2015). Several studies reveal infants as highly social communicators who use a variety of behaviors to communicate long before they speak, including eye contact, gestures, and preverbal vocalizations (Valloton, 2009). Therefore, high-quality teacher-infant interactions are marked by reciprocity, acknowledging infant contributions as central to adult response. Emotional attunement and

investment from teachers are highly important in order to genuinely listen, appreciate and understand the infant (Rutanen & Hännikäinen, 2017; White et al., 2015). Through such attunement, educators are more likely to pay careful attention to infants' needs, interests, and communication attempts, and respond to them appropriately, further developing warm and responsive interactions (White et al., 2015). As infants' interests and needs change rapidly, teachers' sensitivity is crucial, combined with a professional understanding of early development, so that decisions are informed and open to unique infants' experiences (Zhang & Chan, 2019).

Education and Care

Daily routines such as feeding, nappy changing, toileting, and dressing have been recognized as an important context for learning (L. Gillespie & Peterson, 2012; Loizou & Recchia, 2018; Rutanen & Hännikäinen, 2017). Scholars have highlighted that routines should be viewed as pedagogical activities and privileged moments for educators to focus in depth on the unique growth and development of individual infants (Bussey & Hill, 2017; Loizou & Recchia, 2018; Rutanen & Hännikäinen, 2017). Accordingly, taking a holistic perspective on infant development requires a combination of both physical care and education (Loizou & Recchia, 2018). Several authors contend that care and education should operate as a single and indivisible system, with daily routines seen as valuable learning and teaching moments (Bussey & Hill, 2017; Sims et al., 2018). During care moments, educators can invest time and attention to individual children to develop meaningful and emotionally invested interactions (Bussey & Hill, 2017; Sims et al., 2018). The increasing recognition that care and education are intertwined emphasizes the importance of embedding learning and development into infant/toddler care practices, taking advantage of caring opportunities to provide rich learning opportunities. The term *educare* is often used to describe such an integrated approach through which education and care are both valued, favoring a holistic vision of infancy (Bussey & Hill, 2017; Rentzou, 2013; Sims et al., 2018).

However, the potential of routine moments for high-quality interactions has been primarily conceptual or hypothetical, rather than empirically grounded. Indeed, a few observational studies have shown that interactions during routines are likely to be characterized by lower levels of sensitivity and stimulation than play moments (Degotardi, 2010). Past research has suggested that during routines, practitioners follow a more fixed, clear set of actions to meet basic needs rather than focusing on developing sensitive and stimulating interactions (Brownlee et al., 2000; Degotardi, 2010; Loizou & Recchia, 2018). Nevertheless, whereas the crucial role of play is undisputed in the literature, with play being at the core of most European curricular frameworks (Sylva et al., 2015), play may also pose challenges for engaging in high-quality interactions (Loizou & Recchia, 2018). In a recent study focusing on teachers' perspectives based on their own videos, findings revealed that it was not easy for teachers to create learning experiences based on infants' ongoing interests and explorative attempts; teachers stated that it was easier to conduct preplanned activities (Loizou & Recchia, 2018). Thus, while both play and routines are highly valued by scholars, differences in the quality of the interactions across these activities deserve further examination, which may help to identify specific barriers and opportunities for high-quality interactions inherent to these moments.

Adult Presence and Involvement

Several scholars have highlighted the importance of teacher presence and active involvement for high-quality interactions (Dalli et al., 2011; Loizou & Recchia, 2018; Pauker et al., 2018). To develop attentive and responsive relationships, it has been argued that both a physical and emotional presence is required as well as an ability to orient oneself toward the infant experience (Dalli et al., 2011). Observing, listening to infants sensitively and noticing their current interests is thought to require continuous proximity from the teacher and high levels of involvement (Romero-Escudero et al., 2021; Singer et al., 2014; Zhang & Chan, 2019). However, the field lacks much

observational evidence on the levels of adult involvement in infant classrooms and its links to quality interactions. Several empirical studies conducted in toddler and preschool classrooms have shown that the levels of adult involvement do matter for high-quality interactions (Alvim Gonçalves et al., 2020; Goble & Pianta, 2017; Kontos & Keyes, 1999). For example, in one study in toddler classrooms, teachers who displayed higher levels of involvement were more likely to be warmer, more sensitive and to actively promote children's reasoning and thinking (Alvim Gonçalves et al., 2020). In addition, variation in the quality of teacher-child interactions across activities may be accounted for by the type of adult involvement. Kontos and Keyes (1999) found that educators in preschool adjusted their levels of involvement according to the type of activity. For instance, teachers were more likely to display higher levels of active involvement when children were in dramatic play compared to other activities. Similarly, Goble and Pianta (2017) reported that different types of teacher involvement were related to different types of activities in preschool. It seems therefore relevant to further look at the levels of adult involvement in infant classrooms.

The Present Study

The first research aim of this study was to examine the extent to which the quality of teacher-infant interactions varies across play and routine care activities. The quality of teacher-infant interactions was defined as comprising four theoretically based dimensions: relational climate, teacher sensitivity, facilitated exploration, and early language support (details about the measure can be found in the Method section). Based on previous research, we hypothesized that teacher-infant interactions would vary substantially, and that the quality of teacher-infant interactions would be higher during play activities. The second aim was to determine the effects of adult involvement in the quality of teacher-infant interactions. Adult involvement refers to the amount of time teachers spent in verbal and non-verbal behaviors with the infant or the group of infants. Levels of adult involvement can be seen as part of the concept of high-quality interactions because teacher sensitivity, responsiveness and expansion of the infant experience are intrinsically linked to teacher presence, attention and orientation toward the infants. However, it was our intention to more carefully look at the quantity (i.e., time spent) of involvement, to better discern how quantity and quality overlap or are dependent upon each other.

Based on the findings from previous studies, it was expected that higher quantity of adult involvement would be positively associated with higher levels of teacher-infant interaction quality. It was further expected that adult involvement would vary significantly across observation cycles, accounting for important differences across play and routine care activities on the levels of teacher-infant interactions.

Method

Participants

In this study, we observed 90 infant child care classrooms from the greater metropolitan area of Porto, Portugal. Classrooms were participating in a broader study about infants' transition into center-based care and education. Classrooms were included in the study if they met the criteria of the broader project, which were the following: (a) having children under the age of 1 enrolled in the classroom; and (b) having at least one family who registered their infant aged between 4 and 9 months to start attending child care between September 2013 and February 2014. All centers ($N = 418$) from the database provided by the Ministry of Solidarity, Employment and Social Security website in May, 2013, were contacted. Of the total centers, 56% met the first criterion. These centers were randomly sequenced and contacted again. The first 90 centers that met the second project criterion and had agreed to participate, were recruited into the study. One classroom per center was selected. Overall, the

Table 1. Descriptive statistics for study variables at the classroom level.

	<i>N</i>	%	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Teacher characteristics						
Female	90	100%				
Age	90		42.53	9.97	20	64
Years experience	90		8.36	6.51	.08	37
University-level degree in ECE	90	31%				
Center characteristics						
Nonprofit	90	91%				
Urban	90	54%				
Classroom characteristics						
<i>N</i> Adults	90		2.00	0.60	1	3
<i>N</i> Children	90		6.38	2.34	1	12.00
Classroom quality						
Relational Climate	90		4.62	0.77	2.75	6.00
Teacher Sensitivity	90		4.19	0.89	1.75	6.50
Facilitated Learning	90		2.59	0.75	1.25	4.75
Early Language Support	90		2.63	0.76	1.25	4.75

consent rate was 72.6% (75.2% for the nonprofit centers and 53.3% for the for-profit). Of the participating centers, the majority were nonprofit (91%). The location of 54.4% ($n = 49$) was in urban areas (city of Porto or smaller cities) and the others in suburban or rural areas.

Classrooms had, on average, six infants enrolled ($M = 6.38$, $SD = 2.34$), ranging from 1 to 12. The number of adults varied between one and three ($M = 2.00$, $SD = 0.60$), and the average infant-to-adult ratio was 3.83 ($SD = 1.49$) and varied between 1 and 8 children per adult. The age of the youngest child in the classrooms was 4.99 months on average ($SD = 1.14$), and the oldest was 10.8 months ($SD = 2.87$).

All 90 classrooms included one lead teacher and one or more assistants, for a total of 90 lead teachers and 148 assistants. According to Portuguese legislation, child care centers are not required to have a trained teacher in infant classrooms. Regarding the lead teacher, 28 of the classrooms (31%) had a trained lead teacher with a university-level degree in Early Childhood Education (ECE) who spent either part of the day or the full day in the infant classroom. Specifically, 13 of the trained teachers (14%) were assigned to more than one classroom, and thus were not full time in the infant classroom, and 15 of the trained teachers (17%) worked full time in the infant classrooms. In the remaining 62 classrooms, 24 of the lead teachers (27%) had a high-school degree (12 years of schooling), 31 (34%) had basic education (9 years of schooling), and 7 (8%) had only completed elementary school (4–6 years of schooling). All lead teachers were females; all but one were Portuguese. On average, the lead teachers had 8.36 years of experience working with infants ($SD = 6.51$), with a wide range between 1 month and 37 years. Their age ranged from 20 to 64 years ($M = 42.53$, $SD = 9.97$). Descriptive statistics are provided in Table 1.

Portugal has a split system for the education and care of children before their enrollment in mandatory school: one for children under 3 years of age and one for children from 3 to 6, the age of school entry. The first system is regulated by the Ministry of Solidarity, Employment and Social Security, and the latter by the Ministry of Education. Services for the younger group have been growing in number, covering now 50.3% of children, with center-based care (i.e., crèches) being considerably more used than formal family-based care (GEP/MSESS, n.d.). In 2016, center-based care was provided mainly by nonprofit institutions, 74.1%, and only 24.9% were for-profit; about 50% of children attending center-based care were 1 year of age or younger (GEP/MSESS, n.d.).

Procedures

Informed consent was obtained from directors and from the lead teacher for the infant classrooms. The Portuguese Data Protection Authority approved the project and all data collection procedures. To observe teacher-infant interactions and teacher involvement across play and routine care activities, each classroom was live observed during a full morning of 3 to 4 hours by trained observers. On-site visits were conducted from September to March. Observation date and time were coordinated with the

lead teacher, and usually started at the beginning of the day, from the time of arrival of the majority of the infants. Observations included different situations, both structured and unstructured times, play and routine care times, such as feeding, diapering, and putting infants down for a nap. Teachers were asked to follow their usual classroom program.

Following the recommended procedures for the CLASS (Hamre et al., 2014), four live observation cycles were made in each classroom. The cycle included 25 minutes to complete the Classroom Assessment Scoring System–Infant (CLASS-Infant; Hamre et al., 2014) and 10 minutes to complete the Observation System of the Activities and Adult Involvement (OSAI; Cadima et al., 2013). The vast majority of infant settings had more than one teacher interacting with infants, and, for both measures, the observer weighed the contributions of each teacher based on the number of infants with whom the teacher was working, the amount of time she spent with the infants, and her/his responsibility for the activities. During data collection, 75% of the classrooms were observed by one trained observer. To check and maintain inter-rater reliability, 25% of randomly chosen classrooms were double coded by two observers. Lead teachers completed a short questionnaire about their education, training, and experience, as well as other classroom characteristics.

Measures

Quality of Teacher–Infant Interactions

The quality of teacher–infant interactions was measured by trained observers using the CLASS–Infant (Hamre et al., 2014), an observation measure that includes four dimensions: (a) Relational climate, which targets relational behaviors, expression of emotions (e.g., smiling and laughter, and playfulness in the classroom), respect shown by the teacher for the child’s state, and lack of negativity; (b) Teacher sensitivity, which provides an evaluation of teachers’ awareness and responsiveness to infants; (c) Facilitated exploration, which focuses on the extent to which the teacher facilitates the experiences and interactions to support infant development and engagement; and (d) Early language support, which captures teacher talk, support, and extension of communication. The CLASS–Infant uses a 7-point scale and the manual provides specific behavioral indicators for each dimension for *low* (1, 2), *medium* (3, 4, 5), and *high* (6, 7) ranges. The rating is based on observer judgment about the depth, frequency, and duration of interactions and represents the extent to which that dimension is characteristic of that classroom for a given period. CLASS procedures recommend observers to rate at least four 15-minute uninterrupted periods (i.e., observation cycles). After each cycle, observers have 5 minutes to review their observation notes and the manual and use judgment to assign a score for each dimension.

Initial validation of the CLASS–infant has shown criterion validity, specifically, moderate positive associations with the ITERS–R, a widely process quality observational measure for infant and toddler classrooms (Jamison et al., 2014). Positive associations between the CLASS and infant engagement have also been reported (Pinto et al., 2019). The authors also reported considerable face validity, with experts from the early childhood field agreeing that the CLASS Infant covers the most important interaction features that are believed to be relevant for promoting infant development (Hamre et al., 2014).

Observers were trained and certified by one of the coauthors of the CLASS–Infant. During training, observers participated in online sessions with video rating tasks, followed by group discussion of scores. Finally, observers took an online test in which all the observers reached the reliability criterion of 80%. During data collection, to check inter-observer reliability, 25% of the classrooms CLASS–Infant were double coded by one trained observer and one expert observer who acted as a master coder. For the double coded observations, the within-one-point agreement was 99.18%, the mean exact agreement was 65%, and mean weighted kappa was .70.

Teacher Global Involvement

The Observation System of the Activities and Adult Involvement (OSAI; Cadima et al., 2013) was used to collect information on the quantity of adults' involvement with infants. Trained observers registered the time adults were involved in verbal and non-verbal behaviors with an infant or a group of infants, such as talking to infants, answering the infants' verbal bids, smiling and other facial expressions, hugging or holding the infant, physical gestures, or showing toys and materials to infants. After 15 minutes of observation, 7 items were coded on a 5-point scale, with 1 indicating no or limited time involved, 3 indicating that adults were involved nearly half of the time, and 5 indicating that adults spent almost all the time involved with infants. During data collection, 25% of the observations with the OSAI were double coded. Inter-rater reliability showed adequate values. Within-one point agreement was 100% and the weighted kappa was .78.

Type of Activity

Type of activity was derived from the OSAI measure. The OSAI has three questions about type of activity: (a) amount of time playing, (b) amount of time changing diapers, and (c) amount of time feeding the infants. Inter-rater agreement based on 26% of double-coded observation cycles was 98%–100% and weighted kappa was .81–.96. Considering that several cycles of observation included more than one type of activity, three variables (Play, Personal care routine and Mix of play and care routine) were computed as follows. The cycle was scored as Play when the teachers spent more than half of the time playing. The cycle was scored as Personal care routine when the teachers spent at least half of the time changing diapers or feeding. The cycle was scored Mix of play and care routine when either playing, or diapering and feeding were not predominant.

Number of Adults and Children

In each cycle, the number of adults was documented using the OSAI measure and the number of children – awake, sleeping or being fed.

Covariates

A set of covariates was used in the analyses. The Infant Classrooms' Structural Characteristics Questionnaire (QSC-E; Barros et al., 2013) was used to collect child care structural indicators, such as center sector (private for-profit vs. private nonprofit), center location (urban vs. non-urban), lead teachers' education (trained lead teacher vs. non trained lead teacher), and years of experience of the lead teacher in child care.

Data Analyses

Data consisted of four observation cycles in each of the 90 classrooms. To account for the non-independence of cycles, multilevel models were computed, using the Mplus, version 7. Multilevel models are regression models that take into account the sources of variability at each level of nesting (cycle- and classroom-level), preventing biased estimates (Snijders & Bosker, 1999). Multilevel models are regression models that take into account the sources of variability at each level of nesting (cycle- and classroom-level), preventing biased estimates (Snijders & Bosker, 1999). Multilevel models offer several conceptual and technical advantages, as the predictors can be specified at their correct hierarchical levels (cycle- or classroom- level) and therefore be defined correctly (Heck & Thomas, 2015). By combining into a single framework information from within and between levels, multilevel models contribute to more refined explanations of the outcomes (Heck & Thomas, 2015). Considering there were several cycles for each classroom, we performed two-level models, with cycles at level-1

Table 2. Descriptive statistics at the cycle level.

	Cycle 1			Cycle 2			Cycle 3			Cycle 4		
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Teacher-Infant interaction quality												
Relational Climate	90	4.83	1.05	90	4.70	1.03	90	4.63	0.93	90	4.38	1.05
Teacher sensitivity	90	4.41	1.22	90	4.28	1.12	90	4.24	1.11	90	3.93	1.09
Facilitated Learning	90	2.60	1.23	90	2.82	1.15	90	2.79	1.17	90	2.16	1.10
Early Language Support	90	2.78	1.03	90	2.72	1.03	90	2.66	0.94	90	2.41	1.00
Activity setting												
<i>N</i> Adults	90	1.50	0.59	90	1.78	0.61	90	1.91	0.71	90	1.97	0.73
<i>N</i> Children	90	4.39	1.89	90	4.90	2.03	90	5.18	2.16	90	5.32	2.22
% Play	83	29%		82	52%		82	46%		82	27%	
% Routine Care	83	23%		82	17%		84	22%		82	49%	
Global involvement	82	3.13	1.01	82	3.40	0.90	81	3.23	1.05	80	3.11	0.95

(within-level) nested within classrooms at level-2 (between-level). In the within part of the models (cycle level), we tested whether there were differences in interaction quality across cycles. At this level, the intercepts were random effects that could vary across the classrooms and the slopes were fixed effects. In the between-part of the models (classroom level), we tested whether there were differences in interaction quality across classrooms. In the between part of the model, the intercept and residual variance of interaction quality domains were estimated. There were no missing values for the CLASS scores, number of adults and children, whereas 6% of cycles were missing for type of activity, and 10% of cycles for global involvement. Missing values were treated with the Full Information Maximum Likelihood. A series of multilevel models were performed. Preliminary models determined the proportion of variance of study variables at the cycle and classroom levels. Next, a series of multilevel models were performed. The first set of models examined the main effects of type of activity on the quality of teacher-infant interactions (level 1, cycle level). In these analyses, type of activity was dummy-coded so that the effect of personal care and mix was contrasted with play activity (our referent category). The second set of models added levels of adult involvement as a predictor (level 1, cycle level). All models controlled for the effects of a set of covariates, namely, at the cycle level, the number of adults and children in the cycle, and at the classroom level, the lead teacher level of education, the lead teacher years of experience center sector, center location and number of adults and children in the classroom. To further check differences across play and routines, additional multilevel models were performed to examine whether adult involvement, the number of adults, and the number of children varied across play and routines.

Results

Variations Across Cycles: Descriptive Statistics

Tables 1 and 2 display descriptive statistics across classrooms and observation cycles, respectively. Across the observation cycles, teachers exhibited overall moderate levels of Relational Climate and Teacher Sensitivity, and low levels of Facilitated Learning and Early Language Support (see, Tables 1 and 2). As expected, the proportion of variance at the cycle level was meaningful for all CLASS dimensions, specifically, 58% for Relational Climate and Teacher Sensitivity, 63% for Early Language Support, and particularly high for Facilitated Learning and Development, 79%, suggesting that across the morning, there were important variations of teacher-child interactions within classrooms, in particular in the ways teachers facilitated child learning and development.

Regarding the type of activity, in cycles 2 and 3, play was the most prevalent activity, whereas in the last cycle, routine care activity was the main activity in nearly half of the classrooms, likely due to lunchtime often occurring in the 4th cycle. When considering the overall interaction quality throughout the morning, there was a trend for all CLASS dimensions to score lower in the last cycle,

respectively, Relational Climate, $F(3, 267) = 6.29, p = .001$, Teacher Sensitivity, $F(3, 267) = 5.26, p = .002$, Facilitated Learning, $F(3, 89) = 8.23, p < .001$, and Early Language Support, $F(3, 89) = 3.37, p = .019$. The number of adults and children also varied across the cycles within each classroom, respectively, 48% and 51% of the total variance, which was taken into account in the multilevel models. For teacher involvement, 77% of the total variance was at the cycle level, suggesting important variation in the levels of teacher involvement across the cycles of observation. To further check whether adult involvement varied across routine and play activities, a two-level model was performed, with findings showing that adult involvement was higher in play compared to routines, $\beta = -.628, SE = .046, p < .001$, as well as compared to mixed activities, $\beta = -.533, SE = .049, p < .001$ (see, Table 3). A similar procedure was used for the number of adults and children, with results showing that the number of adults did not differ between play and routines, $\beta = -.002, SE = .070, p = .981$, but the number of children was higher during routines than during play activities, $\beta = -.151, SE = .072, p = .037$ (see, Table 3).

Research Aim 1

Our first research aim concerned the extent to which the quality of teacher-infant interactions varied across play and routine care activities. After controlling for a set of covariates, the two-level models revealed that, within classrooms, the quality of interactions of all CLASS domains was lower in routine care activities and mixed activities, compared to play activities (see, Table 4). The quality of teacher-infant interactions was higher in play activities, such that teachers were observed to display higher levels of warmth and respect, were more sensitive to infants' needs, were better able to facilitate infant exploration, and stimulate infants' language development during activities in

Table 3. Descriptive statistics for play, care routine and mix activities.

	Play			Care Routine			Mix		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Teacher-infant interaction quality									
Relational Climate	127	5.13	0.90	91	4.32	1.08	111	4.35	0.95
Teacher Sensitivity	127	4.84	0.99	91	3.73	1.14	111	4.02	1.03
Facilitated Learning	127	3.57	1.00	91	1.80	0.79	111	2.17	0.85
Early Language Support	127	3.24	0.97	91	2.40	0.91	111	2.26	0.89
<i>N</i> Adults	127	1.72	0.64	91	1.89	0.72	111	1.77	0.74
<i>N</i> Children	127	4.82	2.17	91	4.99	1.95	111	4.88	2.17
Global Involvement	126	3.92	0.74	90	2.91	0.79	111	2.68	0.89

Table 4. Results from the multilevel models predicting levels of CLASS dimensions.

	Relational Climate		Teacher sensitivity		Facilitated Learning		Early Language Support	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Within-level (cycle-level)								
Activity ^a								
Care Routine	-.37*	.06	-.34*	.06	-.59*	.05	-.49*	.06
Mixed	-.40*	.06	-.51*	.05	-.72*	.04	-.39*	.06
<i>N</i> Adults	-.13*	.06	-.07	.06	-.01	.05	-.13*	.06
<i>N</i> Children	-.19*	.06	-.25*	.06	-.09	.05	-.11	.06
Between-level (classroom-level) ^b								
<i>N</i> Adults	.28	.20	.25	.20	.18	.23	.12	.20
<i>N</i> Children	-.20	.16	-.22	.16	-.25	.18	.02	.16

Coefficients are standardized.

^aReferent activity is Play.

^bCovariates: all models included as level-2 covariates location (rural vs. urban), sector (public vs. private), teacher education (ECEC degree vs. no degree), and teacher experience (years of experience).

* $p < .05$.

Table 5. Results from the multilevel models predicting levels of CLASS dimensions.

	Relational Climate		Teacher sensitivity		Facilitated Learning		Early Language Support	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Within-level (cycle-level)								
Activity ^a								
Care Routine	-.02	.07	-.06	.07	-.37*	.06	-.12	.07
Mixed	-.11	.07	-.27*	.06	-.53*	.05	-.09	.06
Global involvement	.52*	.06	.44*	.06	.34*	.05	.55*	.06
<i>N</i> Adults	-.13*	.05	-.06	.05	-.01	.05	-.12*	.05
<i>N</i> Children	-.14*	.05	-.21*	.05	-.06	.05	-.06	.05
Between-level (classroom-level) ^b								
Global involvement	.18	.17	.45*	.15	-.34	.21	.05	.17
<i>N</i> Adults	.32	.20	.35	.18	.09	.24	.14	.20
<i>N</i> Children	-.23	.16	-.30*	.14	-.19	.19	.01	.16

Coefficients are standardized.

^aReferent activity is Play.

^bCovariates: all models included as level-2 covariates location (rural vs. urban), sector (public vs. private), teacher education (ECEC degree vs. no degree), and teacher experience (years of experience).

* $p < .05$.

which play was predominant. For Relational Climate, Teacher Sensitivity, and Early Language Support, the type of activity accounted for 16%–23% of the variance at the cycle level. For Facilitated Learning and Development, the variance at the cycle level explained by type of activity was particularly high, 48%. At the cycle level, the number of adults was negatively associated with Relational Climate and Early Language Support. The number of children was also negatively associated with Relational Climate and Teacher Sensitivity, the emotional dimensions of the CLASS.

Research Aim 2

The second research aim was to determine the extent to which adult involvement additionally accounted for variation in the levels of teacher-infant interactions across play and routine care activities. Two-level models showed that adult involvement was positively associated with all CLASS domains (see, Table 5). In addition, after adding adult involvement to the models, differences between play and routine care activities were no longer statistically significant for Relational Climate, Teacher Sensitivity, and Early Language Support, but remained significant for Facilitated Learning and Development. Adult involvement additionally explained 6%–18% of the variance at the cycle level for the CLASS dimensions. At the classroom level, adult involvement was positively associated with Teacher Sensitivity suggesting that in classrooms where teachers displayed on average higher levels of involvement, they tended to be more sensitive to infants' cues and needs.

Discussion

This study intended to examine the variations in the quality of teacher-infant interactions across play and routine care activities. As expected, the quality varied as a function of the type of activity, with teachers displaying higher levels of quality during activities in which play was predominant. Importantly, differences were found in all CLASS domains, suggesting an influence of type of activity both on the emotional dimensions of quality (i.e., Relational Climate and Teacher Sensitivity) and on the cognitive and language stimulation ones (i.e., Facilitated Learning and Early Language Support). Our findings contribute uniquely to the infant toddler literature by pointing out important variations of quality across the morning or the full day (Bussey & Hill, 2017; Loizou & Recchia, 2018; Sims et al., 2018; Slot et al., 2015). It seems that characteristics inherent to the activity may elicit different types of

interactions from the teachers (Slot et al., 2015). Our findings also align with prior qualitative and quantitative studies in infant classrooms pointing to differences between practitioners' play and routine practices (Degotardi, 2010).

There are several explanations for these findings. As it has been suggested (Degotardi, 2010; Degotardi & Davis, 2008), during routines teachers may focus more on the satisfaction of the physical needs than on the provision of warm and sensitive interactions. Prior research has found that teachers' narratives around routines were less elaborated (Degotardi & Davis, 2008) and included fewer theoretical and developmental justifications (Brownlee et al., 2000) than those around play. It is possible that teachers overlook the learning and relationship-building opportunities in routines and have low expectations regarding infant interests and communication attempts during these moments (Degotardi, 2010). Also, the restricted or inflexible time for some of the routines in some classroom (such as for sleep/nap, for example), with standard time periods allocated, can limit responsive practices and the respect for individualized child preferences and needs (Thorpe et al., 2020).

It is also possible that the contextual conditions of routines create constraints for high quality interactions (Guedes et al., 2020). Classroom arrangements such as the spatial layout or the availability of adequate furniture/materials can constrain teachers' practices (Salamon et al., 2016). Of note is that during routines there were more infants in the classroom than during play periods. As the number of children increases, teachers are more likely to need to attend simultaneously to several infants and may feel overwhelmed by all the demands being made. In addition, although not exclusively, nearly half of the observed routines were lunchtime. During such moments, teachers may need to attend to several ongoing managerial demands, such as serving food, feeding, and cleaning. These conditions suggest some of the reasons for lower levels of quality in routines but, as several authors contend, routines should also be seen as privileged opportunities for early learning (Bussey & Hill, 2017; L. Gillespie & Peterson, 2012; Loizou & Recchia, 2018; Zero To Three, 2010). During care moments, adults are often involved in one-to-one interactions, and thus can connect, interact, communicate and build intimate and strong relationships with each infant. Because care routines are attuned to individual needs and interests, they are developmentally appropriate moments to stimulate, scaffold and support holistically infant learning (L. Gillespie & Peterson, 2012). Considering the central role of care routines for high-quality interactions, further in-depth studies are needed to better understand the features that enable and constrain high-quality interactions during these moments.

The second aim of the study was to determine the effects of adult involvement in the quality of teacher-infant interactions. Our findings showed that adult involvement was not only positively related to the quality of interactions, but also partially explained quality differences across play and routines. Several scholars have emphasized the importance of teacher involvement so that teachers are able to attend to one infant's cues about their emotional state and cognitive interests and then provide appropriate contingent responses (Dalli et al., 2011; White et al., 2015). Findings from this study are among the first to provide empirical support for this claim. Even though the CLASS measure implies high levels of teacher involvement, without being possible to disentangle the quantity of involvement from its quality, it is worth mentioning that according to the CLASS, involvement can be a required condition for high-quality interactions, but it is not sufficient.

Also worth noting are the extremely varied levels of adult involvement across play and routines, and the amount of time teachers were not as involved, attentive or available as they could be or are expected to be, particularly during routines. Indeed, the average levels of involvement were low to moderate. This finding is particularly relevant for quality improvement as it suggests that there is room, at least in Portuguese infant classrooms, for increasing the amount of time teachers are involved with infants, which can be a first step to improve the quality of their interactions. Nevertheless, although differences in quality across play and routines were explained by the levels of involvement for most CLASS domains, differences in the quality levels for Facilitated Learning remained. High levels of Facilitated Learning are characterized by teachers' attempts to maintain a child focus, such as allowing infants to have choice in their experience and providing exploration opportunities, combined with consistent expansion of infants' experience, namely through physical and verbal encouragement and

materials adjustment (Hamre et al., 2014; Jamison et al., 2014). Play may provide more opportunities for infant initiatives and exploration, given spatial conditions that allow infants to move more freely, but it is also possible that infants are expected to interact with materials and their peers in free play and thus, teachers' expectations might play a role on creating and taking advantage of such learning opportunities. Infants' agency may be better acknowledged, respected and stimulated in play moments compared to others (Degotardi & Davis, 2008). For example, one recent study found that teachers considered infants as more capable of independently directing their own physical and cognitive learning, but were considered less independent in their emotional and social development (Salamon et al., 2016). Although the latter study did not examine differences across play and care routines, it nevertheless points to the complexity, including incongruities and inconsistencies, of teachers' conceptions around infant development and pedagogy.

Although it was not the aim of our study, it is important to mention how the number of adults within the classroom affected the results. Whereas, as expected, a higher number of children was related to lower levels of emotional climate and teacher sensitivity, surprisingly, the number of adults in the classroom was negatively linked to the emotional climate and early language support, above and beyond the number of children or the levels of adult involvement. Possible reasons for the negative associations in the present study are that a greater number of adults may result in greater inconsistency among them, less collaboration among adults, as well as more adult-adult talk than adult-child talk. Moreover, additional members of staff are usually non-qualified staff, such as cleaners and cooks who assist staff in classrooms during certain periods of the day, such as assisting infants with their meals (Katsiada et al., 2018). Their role is usually overlooked in the literature, but recent evidence suggests that they can have a much more active and substantial influence in infant's education and care that has been previously acknowledged (Katsiada et al., 2018). In trying to interpret our findings, it is possible that additional staff do not have the qualifications needed to interact sensitively and adequately with infants and/or do not know infants enough well to adjust their behaviors.

It is also possible, however, that observing and scoring more adults is more challenging for observers than observing fewer adults. We note, however, that interrater agreement in this study was good and that the CLASS manual and training provide clear guidelines to deal with such situations. Nevertheless, our findings point to the need to better understand the role of each adult, which is aligned with recent studies showing that the quality of interactions varied across adults within a classroom (Bjørnstad et al., 2019; Pauker et al., 2018).

Overall, this study shows that the quality of interactions is not consistent across different moments of the day and highlights that the context of the activity and the levels of adult involvement are some of many other features that should be taken into account to better understand the kind of interactions infants experience in ECEC. Importantly, this study concurs with recent findings calling for the importance of more refined and nuanced understanding of classroom process quality, as ratings of global quality measures may obscure relevant intra-classroom variability.

Limitations and Future Directions

Several limitations should be acknowledged when interpreting the results from this study. First, this study did not examine infants' individual behavior or levels of engagement. Some studies have shown that infants bring unique characteristics and developing behaviors to interactions and that teachers adjust their behaviors contingently (Valloton, 2009). It is possible that infants' ability to act and communicate may have influenced the quality levels. Second, many observational cycles were coded as mixed, involving both play and care routines within one cycle of observation. This highlights the interrelated nature of play and care and calls for further research with more refined measures of the activity context. Also, in this study, we did not explore the sequence of cycles and the stability or change in interaction quality across the morning. Prior studies in preschool have shown that process quality levels tend to decrease over the day (von Suchodoletz et al., 2014). Although our observational cycles included a broad range of routines, such as assisting children in sleep, diaper changing and

feeding, those routines were not examined separately and each one can offer specific barriers to high-quality interactions. More studies are needed with a closer look at different routines. In addition, as previously stated, although quality observations did take into account the behaviors of the several adults present in the room, it was not possible to capture each one individually. Finally, we used a rough measure of adult involvement. More refined measures on levels of each adult involvement would contribute to advance our knowledge on the variations of quality within a group of infants.

In sum, findings from the present study showed that the quality of teacher-child interactions was higher during play, compared to care moments. Further, findings highlight that both the quality and quantity of teacher involvement with infants are crucial to high quality. Findings call attention to the importance of considering the intra-classroom variability, and of giving greater emphasis to the care moments, so that a holistic approach in which care and education are intertwined can be accomplished.

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ORCID

Joana Cadima  <http://orcid.org/0000-0002-8814-8899>

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