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## The quality of caregiver–child interactions in infant classrooms in Portugal: the role of caregiver education

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### ABSTRACT

Recent research has shown that caregiver education and training can be important in determining levels of quality in early childhood, but has mainly considered the education and training of the lead teacher. In infant child care, however, classrooms have more than one caregiver with varying levels of education and in Portugal it is less common to have a qualified teacher exclusively assigned to infant classrooms. This study examines the quality of caregiver–child interactions in infant classrooms and its association with caregiver qualifications and training, specifically the level of pre-service education and in-service training of the lead caregiver, whether she is exclusively assigned to an infant classroom or to more classrooms, and the pre-service education of the multiple caregivers in the classroom. Participants were 90 infant classrooms from Porto, Portugal. The CLASS–Infant was used to measure quality of caregiver–infant interactions. Classrooms with one lead caregiver holding at least a bachelor's degree, whether exclusively assigned to the infant classroom or not, showed higher levels of quality. Few effects were found for in-service training. Results suggest that lead teachers with pre-service education in early childhood are likely to play an important role not only directly by interacting with children but also indirectly through team work.

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## Introduction

Caregiver education and specialised training have been highlighted as important determinants of quality in early childhood education and care (ECEC), and are among the more regulable characteristics that stakeholders and policy-makers rely on to improve the services provided to young children and their families.

To study the effects of caregiver education on classroom quality, research has mainly considered the educational level of the adult responsible for the group (i.e. the lead teacher; e.g. Castle et al. 2016; Cryer et al. 1999; Early et al. 2007). Research has also typically focused on preschool classrooms rather than in infant and toddler classrooms where it is less common

to have full-time qualified teachers, especially in countries with two different systems of ECEC for children younger or older than 2 or 3 years of age (cf., Jensen and Iannone 2015). In Portugal, in particular, infant classrooms are not required to have a qualified teacher (Portaria n.º 262/2011, August 31). This study expands previous literature by examining the quality of caregiver–child interactions in Portuguese infant classrooms and its association with caregiver education, considering all caregivers’ formal education, including lead caregivers and other staff members, and whether a qualified teacher is exclusively assigned to the infant classroom or not.

### *Importance of global ECEC quality and caregiver–child interactions*

Extensive ECEC literature documents positive effects of attending high-quality preschools (3–5 years old) on child development outcomes, such as academic, social or executive function skills (e.g. Abreu-Lima et al. 2013; Anders et al. 2013; Bryant et al. 2003; Burchinal et al. 2015; Lehl, Kluczniok, and Rossbach 2016; NICHD ECCRN 2006; Peisner-Feinberg et al. 2001; Pinto, Pessanha, and Aguiar 2013). Research in multiple countries also supports the positive effects of attending high-quality infant/toddler classrooms on child outcomes, namely in England (Sylva et al. 2011), in Portugal (Pessanha, Pinto, and Barros 2009), in the Netherlands (de Schipper, van Ijzendoorn, and Tavecchio 2004), and in the US (e.g. Burchinal et al. 2015; NICHD ECCRN 2006; White, Peter, and Redder 2015). In addition, evidence is building that there may be a threshold effect in the quality-outcomes relation; that is, higher quality may be related to language and literacy gains, as well as to cognitive skills, but only in the good-to-high range of classroom quality (Burchinal, Kainz, and Cai 2011; Ruzek et al. 2014; Zaslow et al. 2016).

Although classrooms exclusively for infants have been less studied than preschool or than combined infant/toddler classrooms, available evidence suggests that the quality in infant/toddler classrooms, including quality of adult–child interactions, is typically in the low to medium range, raising concerns about children’s development in the early years (Barros and Aguiar 2010; LaParo, Williamson, and Hatfield 2014; NICHD ECCRN 2000). In one of the few studies involving exclusively infant classrooms in the US ( $N = 30$ ) teacher–child interactions, measured with the same instrument that was used in the present study, the Classroom Assessment Scoring System–Infant (CLASS–Infant), were only in the medium quality range (e.g. Jamison et al. 2014).

The quality of adult–child interactions – often called process quality – is considered a crucial dimension of ECEC environments. To support positive development, ECEC contexts must include responsive and cognitively stimulating daily interactions between caregivers and children (Jamison et al. 2014). Much basic learning in the early years occurs through interactive experiences (Kontos and Wilcox-Herzog 2002). For young infants, this is particularly important, in ECEC and at home, as they completely rely on adult initiative to have access to materials, experiences, and language, and to meet their basic needs (Barros et al. 2016). In out-of-home contexts, teacher–child relationships constitute a critical caregiving context for infant and toddler learning and development (Leach et al. 2008; LaParo, Williamson, and Hatfield 2014; Mortensen and Barnett 2015; NICHD ECCRN 1998; Ruzek et al. 2014). Therefore, caregivers must be consistent, responsive and sensitive to infant needs and interests as they interact throughout the day in naturally intimate caregiving

tasks (Mortensen and Barnett 2015). The effects of caregiver education and training on the quality of these interactions are the main focus of the present study.

### ***Associations between ECEC quality and caregiver education and training***

Associations between ECEC process quality and structural features have been extensively explored in the last decades. Process features are considered more dynamic and refer to children's direct experiences, such as the frequency and type of teacher–child interactions (e.g. Bryant, Burchinal, and Zaslow 2011; Cryer 1999). Structural features are considered more static and are usually defined as more quantitative, easily measured or observed aspects, which can be regulated (e.g. Peisner-Feinberg and Yasejian 2010). These features are commonly regulated at the state or country level and are considered as setting the conditions for process quality (Cryer et al. 1999). Caregiver education (formal pre-service education) and in-service training in ECEC, together with other structural features, such as child:adult ratios, group size, caregiver experience and working conditions, are frequently included in studies predicting process quality (OECD 2015; Peisner-Feinberg and Yasejian 2010; Slot et al. 2015; Whitebook, Howes, and Phillips 1989). In infant and/or toddler classrooms, some previous studies found that the quality of relationships between caregivers and children tended to be higher when group size was lower (e.g. Deynoot-Schaub and Marianne Riksen-Walraven 2005; NICHD ECCRN 2000) and when ratios were also lower (e.g. Barros and Aguiar 2010; Cost, Quality, & Child Outcomes Study Team 1995; Jamison et al. 2014). Furthermore, significant associations were found between a greater number of adults and higher caregiver sensitivity (e.g. Goelman et al. 2006). However, other studies did not find any associations between global or process quality and group size (e.g. Pessanha, Aguiar, and Joaquim Bairrão 2007; Slot et al. 2015; Vermeer et al. 2008), child:adult ratio (e.g. Slot et al. 2015; Vermeer et al. 2008) or number of adults (e.g. Pessanha, Aguiar, and Joaquim Bairrão 2007). Better working conditions, such as salaries and working hours, have been associated with higher process quality, but research has recently highlighted that working conditions might co-vary with staff qualifications, making it difficult to single out the effect of a particular characteristic (OECD 2015).

### ***Caregiver qualifications***

Over the past decades, increasing requirements for caregivers' formal pre-service education has been one of the most frequently adopted policies to improve ECEC quality (Bryant, Zaslow, and Burchinal 2010; Burchinal et al. 2002). However, mixed and inconclusive results have been found in the many studies of the association between process quality and caregiver education and training. Partly, this may be due to the diversity of measures used to assess process quality and partly to differences among the programmes being assessed (Kontos and Wilcox-Herzog 2002). More importantly, 'caregiver education' and 'teacher training' seem to be, in fact, understood and measured in different ways limiting the ability to draw robust conclusions from the existing literature.

Caregivers' pre-service education has been operationalised in at least three distinct ways: (a) number of years of formal education; (b) highest degree attained, irrespectively of the scientific area and commonly dichotomized as having a college degree or not, i.e. bachelor, or in more categories from lower secondary (grades) to vocational education to university level; and (c) possession of a specialised pre-service qualification in ECEC/Child Development.

The level of education, as measured either by the number of years or by the highest degree attained, has been associated with higher ECEC process quality in several studies and in different countries (e.g. Abbott-Shim, Lambert, and McCarty 2000; Cryer et al. 1999; in the US and Spanish samples from a group of four countries; Phillipsen et al. 1997; Slot et al. 2015; Thomason and LaParo 2009; Vogel et al. 2015). However, very weak or null relations were found in other studies or with other samples (e.g. Cryer et al. 1999, in the Portuguese and German samples; Hu et al. 2016; Phillips et al. 2000; Vermeer et al. 2008). It is noteworthy that Early et al. (2007) using seven large data-sets involving more than 2000 ECEC classrooms, and using the same set of analyses and controls, found no evidence supporting robust associations between the highest level of education attained by the lead teacher and ECEC quality.

Caregiver pre-service specialised qualifications in ECE also appear to be inconsistently associated with higher quality ECEC (e.g. Castle et al. 2016; Phillips et al. 2000). For example, Castle et al. (2016) in a study exploring relations among lead teachers' characteristics, such as the field of their degree, and their interactions with children below 36 months of age, found a significant positive association between field of degree and teacher-child interactions: lead teachers with degrees in ECE provided higher levels of emotional and instructional support than those with degrees in other fields. However, in Portugal, where a bachelor's degree overlaps with a specialisation in ECEC, Barros and Aguiar (2010) found no effects of having a trained lead teacher (vs. a non-trained lead caregiver) in the global quality of toddler classrooms, after controlling for other structural correlates. Moreover, education level and training in ECE tend to be associated or interconnected, making it difficult to disentangle their effects (Kontos and Wilcox-Herzog 2002; Pianta et al. 2005). In one study, Pianta et al. (2005) combined both indicators, and found that classroom process quality was higher when the lead teacher had a college degree (BA) and a specialised qualification in ECE.

Mixed results have also been found when considering or comparing different age groups. For example, Phillips et al. (2000) reported that lead teacher pre-service training in ECEC was a predictor of quality in infant and toddler classrooms but not in preschool, whereas Phillipsen et al. (1997) reported that teacher education more strongly predicted process quality in preschool than in infant/toddler classrooms. These results suggest that there is a need to clarify the specific content of caregiver education and of specialised qualification in ECE in order to identify the specific indices of training that may be associated with process quality for specific age groups.

### *In-service training*

Considering the contradictory findings between process quality and caregiver qualifications, some authors acknowledge that in-service training activities (i.e. continuous training) support higher quality interactions with children (Early et al. 2007). In fact, evidence is growing that several types of in-service training are positively associated with higher quality (e.g. Burchinal et al. 2002; Cassidy et al. 1995; Hamre et al. 2012; LoCasale-Crouch et al. 2011). For instance, a review of studies from 1980 to 2005 revealed a significant positive effect of specialised in-service training focusing teacher interactions on the pedagogical competencies of caregivers in child care (Fukkink and Lont 2007). A recent Dutch study (Slot et al. 2015) showed that the frequency of use of a wide range of professional development activities at the ECEC centre (e.g. having regular staff meetings to discuss developmental and

educational goals, discussing children with specific needs, personal coaching opportunities) was positively associated with emotional and educational process quality (CLASS-Toddler).

### *Daily continuity of caregivers*

Studies analysing associations between child care quality and caregiver qualifications often do not take into account caregiver daily transitions between classrooms. In child care, and mainly to guarantee legal requirements concerning child:adult ratios, it is rather common that caregivers do not spend their entire workday in the same classroom, with possible impact in the estimation of the effects of teacher qualifications in child care quality and child outcomes (Setodji, Le, and Schaack 2012). Caregiver discontinuity throughout the day, and also child movements between classrooms, are considered to interrupt teacher-child relationships, and may have a negative impact on child development (Le, Schaack, and Setodji 2015). Continuity of caregivers in the classroom can reduce stress related to transitions and can enhance the consistency of relationships between infants/toddlers and adults (Cryer, Hurwitz, and Wolery 2000). Findings from different studies seem to indicate that stable care experiences, corresponding to a continuous history of children in child care (Ahnert, Pinquart, and Lamb 2006) and to longer periods of time in the classroom and less movements between classrooms (Le, Schaack, and Setodji 2015), are important to create secure relationships and for caregivers to provide more sensitive and responsive care, based in a longer period of interactions and mutual knowledge. Accumulated experiences with a child may facilitate a higher emotional investment in the child and enable the caregiver to appropriately read child cues and respond accordingly, as well as promote child trust and empathy for others (Le, Schaack, and Setodji 2015). Furthermore, infant and toddler adjustment to the child care setting has been positively associated with greater availability of one or more of their trusted caregivers (de Schipper, van Ijzendoorn, and Tavecchio 2004). In a recent study in preschool classrooms (Le, Schaack, and Setodji 2015), caregiver movements were negatively associated with perceived closeness between caregivers and children, and positively related to perceived conflicts. Surprisingly, links between daily discontinuity and process quality in classrooms for young children have received far less attention.

### *Qualifications of all staff*

Another limitation from the literature is the almost exclusive focus on lead teachers' education and/or training, although regulations almost everywhere require at least two adults in an early childhood classroom. Considering the demanding needs of younger children, their classrooms require more than one adult, and often the long hours of children's attendance may only be ensured by different caregiver shifts (Setodji, Le, and Schaack 2012). These additional caregivers are seldom included in research studies, but there are some exceptions. For example, Howes, Whitebook, and Phillips (1992) studied the lead teacher and one assistant caregiver in each classroom, and found that in infant and toddler classrooms, specialised pre-service education in ECE of all staff had a positive effect in the quality of their interactions. Leach et al. (2008) aggregated pre-service education levels of all adults who worked in the setting, and did not find significant associations. Slot et al. (2015) considered the highest level of education of any caregiver in the classroom, and found a positive, but small association, between caregivers' formal pre-service education and emotional process quality. It seems, therefore, important to consider the qualifications of all staff.

It is additionally important to note that observation measures of quality usually capture the quality of the interactions of all staff members. Although the lead teacher has a greater responsibility for the activities, the other adults might also impact direction, depth and variety of interactions that constitute the typical experiences of the infants in the classroom.

In sum, the lack of clear and comprehensive operationalisations of caregiver education and training might contribute to the inconsistencies found in the literature. Additional and clearer information is needed, namely on how education levels are defined and how different caregivers in the classroom are considered, in order to better understand and more accurately interpret results of the association between caregiver education, caregiver training and ECEC process quality. Moreover, variations in the educational and child care systems across countries need to be considered as they may also contribute to heterogeneity and inconsistency of results.

### ***ECEC and caregiver education in Portugal***

Caregiver education is particularly relevant in Portugal, considering the high variation in staff qualifications, as regulations do not require caregivers in infant classrooms to have any training in ECEC nor even any specific formal education beyond the mandatory years of school. In addition, in infant child care, in comparison to toddler classrooms and preschool, as above-mentioned, it is less common to have a full-time qualified teacher.

ECEC in Portugal, similarly to nearly half of the European countries (European Commission/EACEA/Eurydice/Eurostat 2014), is organised in two different systems: one for children under age 3, which is regulated by the Ministry of Labour, Solidarity and Social Security; and one for children from 3 years old to beginning of mandatory school at age 6, which is regulated by the Ministry of Education. Regulated child care settings for children under 3 years old include centre-based care (i.e. crèche), in private for profit and private non-profit institutions, and home-based care (i.e. family day care), although home-based care is less used. In 2014, places in these formal settings together were available for 49.2% of children younger than 3 years old (GEP/MSESS, n.d.). The proportion of family day care varies by district; in the district of Porto, family day care only represents around 5% of all places available. The participation rate of children under the age of 3 in crèche in Portugal is one of the highest in Europe (28% European average; 35% in Portugal) as is the number of hours per week that children spend in centre care (39.5 h in Portugal, compared to the 26.4 h European average; European Commission and Eurydice 2014).

Some European projects have highlighted differences and commonalities between countries regarding ECEC systems and curricula (e.g. Gregoriadis et al. 2014; Jensen and Iannone 2015) and also regarding teacher education. An analysis of pre-service education in 10 European countries concluded that there is a broad trend to increase demand for university-level qualifications, although substantial differences exist between countries in the study programmes, contents, main principles and practical experiences provided (Jensen and Iannone 2015). Portuguese legislation (Portaria n.º 262/2011, August 31) requires early child care centres to have a qualified lead teacher, with a master's degree in ECEC, in each classroom for toddlers (1–2 years old and 2–3 years old), but not in classrooms for infants. Currently, master programmes in ECEC in Portugal last for 3 or 4 semesters (the latter certifying teachers for both preschool and elementary school) and include mandatory practicum (Decreto-Lei n.º 79/2014, May 14th). Master programmes are provided by

universities and polytechnic institutes, with similar study plans and learning objectives. Infant classrooms are only required to have assistant/aide caregivers. Qualified teachers and assistant responsibilities are defined by official documents (Contrato coletivo entre a Confederação Nacional das Instituições de Solidariedade – CNIS e a FNE – Federação Nacional da Educação e outros – Revisão global, April 2016). Assistant caregivers are responsible for: participating in socio-educational activities; helping with personal routine care (meals, hygiene and comfort); supervising children in the classroom and during nap; taking care of children in transportation, playground, field trips. In the same document, qualified teacher/educator (i.e. with a qualification in ECEC) responsibilities are defined as: organise and use the appropriate educational means to promote child development (i.e. psychomotor, affective, intellectual, social and moral development), and monitor the development of the child, and maintain communication with the parents in order to achieve an integrated educational action.

Legislation applicable to centres that exclusively have classrooms for infants and toddlers (i.e. *crèches*) does not specify requirements related to education for the aide caregivers. As in other professions, auxiliary staff must comply with the mandatory schooling applicable at the time they were in the school system. It is thus possible that a relatively older caregiver of infants may have only four years of primary school education because in Portugal, six years of elementary education were mandatory only after 1964. Nowadays, 12 years of school (secondary level) or attending school until age 18 are mandatory (Lei n.º 85/2009, August 27).

Due to the less stringent requirements for lead caregivers in infant classrooms and for auxiliary staff members in all classrooms, Portuguese child care centres have caregivers with widely varying levels of formal education, especially in classrooms for younger children. In a previous study in Portuguese toddler classrooms, some lead teachers had as few as 5 years of primary education (Barros and Aguiar 2010). In-service training requirements are not specified in child care legislation.

### ***The current study***

Considering that many classrooms have more than one caregiver with varying levels of formal education it seems important to investigate their role in the quality of the experiences provided for children attending child care settings. This is particularly important in infant classrooms, where it is less common to have a qualified teacher assigned to the infant classroom. In Portugal, considering the above mentioned legislation requirements, levels of education of auxiliary teachers can be rather low. The effect of all caregivers' education, to our knowledge, has been scarcely examined.

The purpose of this study is to explore the links between the quality of caregiver–child interactions and staff education and training, considering the levels of pre-service education and in-service training of the lead caregiver, her daily classroom movements, and the pre-service education of the multiple caregivers in a classroom. First, following prior research in which only lead caregiver characteristics are considered, we examine the associations between quality of the caregiver–child interactions in infant classrooms and both the lead teacher pre-service education and whether the lead caregiver had attended training workshops. Second, we examine the relationship between the quality of the caregiver–child interactions and levels of pre-service education of all caregivers, taking into consideration

whether the caregiver daily moves in and out of the infant classroom and whether the caregiver holds the responsibility over the group.

## Method

### Participants

Data for this paper are part of a research project about infants' transition into centre-based care and education ('Infant transition to child care: parent-caregiver communication, early education quality and infant adjustment'). Ninety infant child care classrooms from the greater metropolitan area of Porto, Portugal, participated in this study.

Of the 418 centres in this metropolitan area, registered at the Ministry of Solidarity, Employment and Social Security, 232 had an infant classroom. These centres were contacted following a random sequence, and the first 90 centres that met the broader project criteria (namely, 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) were enrolled in the study. The overall centre consent rate was 72.6%, although it differed by centre status: among the for-profit centres contacted that met the criteria, eight participated in the study and seven directors did not agree to participate; among the non-profits, 82 centres participated in the study and 27 refused to participate. All data collection measures and procedures were approved by the Portuguese Data Protection Authority and informed consent was obtained from director, lead caregivers and parents.

The majority of the 90 centres were non-profit (91%), and 49 (54.4%) were located in urban areas (city of Porto or other smaller cities included in the greater metropolitan area of Porto); the others were suburban or rural. On average, the youngest child in the classrooms was 4.99 months ( $SD = 1.14$ , range 3–9 months) and the oldest 10.79 months ( $SD = 2.87$ , range 6–23 months).

Table 1 includes demographics of caregivers and classrooms. All 90 classrooms had one lead caregiver and one or more assistants, and totalled 238 caregivers. The number of caregivers reported per classroom ranged from 2 to 5, and the number of children ranged from 1 to 12, with a reported infant:adult ratio of 2.48. On average, caregivers worked approximately 7 h per day ( $M = 6.97$ ,  $SD = 0.95$ ). Of the total number of caregivers with available demographic information ( $n = 232$ ), 43 (18%) held a university-level degree in ECEC, 82 (35%) had a high-school degree (upper secondary level, 12 years of schooling), 75 (32%) had basic education (lower secondary school, 9 years of schooling) and 32 (14%) completed elementary school (4–6 years of schooling). On average, lead caregivers had 8.36 years of experience working with infants ( $SD = 6.51$ ), and their age ranged from 20 to 64 years old ( $M = 42.53$ ,  $SD = 9.97$ ). All caregivers were females.

### Measures and procedures

Each classroom was observed during one full morning to score the CLASS–Infant. Caregivers completed a short questionnaire (Infant Classrooms' Structural Characteristics Questionnaire) about education and training, experience, and classroom enrolment. Data were collected between September 2013 and March 2014 by trained observers. Measures are described below.

**Table 1.** Descriptive statistics for classroom and caregiver characteristics at the caregiver and classroom levels.

	<i>n</i>	%	<i>M</i>	<i>SD</i>	Min–Max
Lead caregiver ( <i>n</i> = 90)					
Teaching experience (years)			8.36	6.51	0.08–37.00
Highest level of education					
University-level degree in ECEC	28	31			
Upper secondary	24	27			
Lower secondary	31	34			
Primary school	7	8			
In-service training					
Short courses & professional meetings	52	58			
Workshops (>24 h)	21	23			
	31	34			
Assistant caregivers ( <i>n</i> = 148)					
Highest level of education <sup>a</sup>					
University-level degree in ECEC	15	11			
Upper secondary	58	41			
Lower secondary	44	31			
Elementary school	25	17			
Classroom-level variables ( <i>N</i> = 90)					
Classrooms w/qualified lead caregiver exclusively assigned to the classroom	14	15.6			
Classrooms w/qualified lead caregiver assigned to several classrooms	14	15.6			
Classrooms w/qualified caregiver who is not the lead caregiver	14	15.6			
Reported number of caregivers			2.64	0.64	2.00–5.00
Reported number of children			6.38	2.34	1.00–12.00
Reported infant:adult ratio			2.48	0.95	0.50–5.00
Observed infant:adult ratio			2.24	0.87	0.67–5.50

<sup>a</sup>Information pertaining 142 assistants.

### **CLASS–Infant (Hamre et al. 2014)**

CLASS–Infant is an observation measure that captures the quality of teacher–child interactions in ECEC classrooms for infants. This measure was developed based on the Classroom Assessing Scoring System (CLASS; LaParo, Hamre, and Pianta 2012; Pianta, LaParo, and Hamre 2008). Although developed in the US, the CLASS–Pre K is widely used in several European countries, including Portugal. Its reliability and validation for different sociocultural contexts has been documented in literature (Cadima, Leal, and Burchinal 2010; Curby et al. 2009; Hamre et al. 2007; Pakarinen et al. 2010).

The CLASS–Infant is organised in four dimensions: (a) Relational Climate that reflects the level of positive and close relationships between caregivers and infants, as well as the degree of general happiness, playfulness, respect and absence of negativity in the classroom; (b) Teacher Sensitivity that provides an evaluation of caregivers' responsiveness and awareness to all infants in the classroom; (c) Facilitated Exploration that captures the level of caregivers' active involvement, provision of exploration opportunities and encouragement to all infants; and (d) Early Language Support that refers to the caregivers' ability to ensure a frequent, high-quality language environment and expand infant vocalisations and other communication indications. Each dimension is scored after a 15-min observation, in a total of four observation cycles across a typical morning. Observers weighed the behaviours of all adults in the classroom, considering the amount of time and the number of children they interacted with, as described in the CLASS–Infant manual (Hamre et al. 2014). A seven-point Likert scale, ranging from low (1, 2), to middle (3, 4, 5) and high (6, 7), is used. Following the CLASS standard protocol, scores were averaged across cycles per CLASS dimension.

Data were collected by trained observers, who during training reached the within-1-point reliability criterion of 80%. Observers had the supervision of a master coder during their first data collection observation, and 25.6% of all observations were doubly coded with the expert observer. The exact agreement averaged 65.22%, within-1-point agreement averaged 99.18%, and weighted kappa was 0.70. Infant:adult ratio was computed for each of the cycles of observation conducted in each classroom and then averaged; observed mean infant:adult ratio ranged from 0.67 to 5.50, thus exceeding the national limit of 5:1 (Portaria n.º 262/2011, August 31) in some classrooms.

### *Infant Classrooms' Structural Characteristics Questionnaire (QSC-E; Barros et al. 2013)*

Lead teachers completed a questionnaire designed to collect several child care structural indicators, including caregiver's, classroom and centre characteristics. For the present study, the following data were used in the analyses: (a) education level of the lead teacher and whether she had a university-level degree in ECEC; (b) whether the lead teacher attended any kind of in-service training activity within the last 12 months, including short courses, professional meetings and workshops – corresponding to at least 24 h of training; (c) working conditions (salary and working hours) of the lead caregiver and time for interacting directly with children and for planning; (d) whether the caregiver was permanently assigned to the infant classroom or was assigned to more than one classroom; and (e) infant:adult ratio, considering the reported number of adults and children enrolled. In addition, data on the education level of the multiple caregivers within a classroom and whether they had a university-level degree in ECEC was used.

### *Data analytical procedure*

First, a set of descriptive analyses were conducted regarding the four CLASS dimensions of classroom quality and levels of formal education among the various caregivers in each classroom. Next, to determine the extent to which holding a specialised degree in ECE was related to observed quality of caregiver–infant interactions, a series of analyses were conducted. The first set of analyses involved only the lead caregiver and examined the extent to which either the highest level of formal education or attending workshops were related to a set of caregiver and classroom characteristics and to observed quality, through group comparisons. Cohen's *d* was computed to determine the effect size of the differences, with effect sizes of 0.20 indicating a small effect, 0.50 a medium effect and 0.80 a large effect.

In the following set of analyses, the qualifications of both lead and assistant caregivers were taken into consideration. In order to gain a fine-grained picture of the effects of the role of the caregivers and daily movements in and out the classroom (i.e. assigned exclusively to the infant classroom or to more than one classroom), a set of classroom-level variables were computed to indicate whether the classrooms had (a) a lead or assistant caregiver with a university-level specialised degree in ECEC, (b) a lead teacher with a university-level specialised degree in ECEC or (c) a lead teacher with a university-level specialised degree in ECEC who was permanently assigned to the infant classroom. Specifically, three dichotomous variables at the classroom level were computed, using a successively more restrictive criterion. For the first variable – Qualified lead/assistant caregiver – the inclusion criterion (=1) was the least stringent and included any caregiver holding a university degree in ECEC, either being the lead caregiver or not, and working permanently in the classroom or not ( $n = 42$ ). For the second variable – Qualified lead caregiver – the inclusion criteria (=1) was

more stringent and included caregivers holding a university degree in ECEC who were the lead caregivers, either permanently assigned to the classroom or moving daily in and out of the classroom ( $n = 28$ ). For the third variable – Qualified permanent lead caregiver – the inclusion criterion ( $=1$ ) was the most stringent, and only included lead caregivers holding a university degree in ECEC and permanently assigned to the infant classroom ( $n = 14$ ). A series of multivariate multiple regression models predicting the four CLASS dimensions were then tested and compared, using nested predictors, to explore which model best fit the data. Models were compared using two model fit indices: (a) the Akaike information criterion (AIC; Akaike 1987), and (b) the coefficient of determination R-square. The AIC statistic is a comparative measure of fit that is based on an information theory approach to data analysis and is useful to compare different models that are not hierarchically related, that is, models estimated with the same data containing different combinations of predictors (Kline 2011). A small value represents a better fit of the data and thus, within a set of competing non-hierarchical models, the model with the lowest AIC is the best fitting model. R-square is a widely-used statistical measure of the goodness of fit of a model that indicates the percentage of variance in the outcomes that is accounted by the model predictors. R-square is also a very useful measure of the substantive importance of an effect (Field 2009), and it is often used as a measure of effect size. The models were performed under ML estimation using the statistical software package Mplus version 6.1 (Muthén and Muthén 1998–2010). This analytical approach allowed us to obtain enough power to detect potential effects between specialised degree in ECEC vs. no qualification, considering the role (i.e. lead caregiver) and daily continuity (permanently assigned to the infant classroom or assigned to more than one classroom) compared to a simple group comparison approach, given the small number of classrooms in each group.

## Results

### Classroom process quality

Regarding the CLASS dimensions, the mean scores for Relational Climate and Teacher Sensitivity indicated that the emotional quality of caregiver–child interactions was in the medium range ( $M = 4.62$ ,  $SD = 0.77$ , and  $M = 4.19$ ,  $SD = 0.89$ , respectively), but ranged from low (1.75) to high (6.50) in these dimensions. In contrast, the mean scores for Facilitated Exploration and Early Language Support were in the low range of quality ( $M = 2.59$ ,  $SD = 0.75$ , and  $M = 2.63$ ,  $SD = 0.76$ , respectively). Table 2 presents the correlations

**Table 2.** Associations among variables.

	1	2	3	4	5	6	7	8
1. Relational Climate								
2. Teacher Sensitivity	0.75*							
3. Facilitated Exploration	0.66*	0.58*						
4. Early Language Support	0.66*	0.68*	0.72*					
5. Observed infant:adult ratio	−0.06	−0.19	−0.22*	−0.05				
6. Qualified caregiver	0.12	0.23*	0.20	0.32*	−0.26*	0.57*		
8. Qualified lead caregiver	0.18	0.24*	0.30*	0.39*	−0.30*	0.47*	0.72*	
9. Qualified lead caregiver exclusively assigned to infant classroom	0.14	0.19	0.28*	0.21*	−0.30*	0.24*	0.46*	0.64*

\* $p < 0.05$ .

among CLASS dimensions. As expected, the four dimensions were highly intercorrelated ( $r = 0.58\text{--}0.75$ ).

### **Caregiver pre-service education and professional development activities**

Table 1 shows characteristics of the caregivers in general. Over 30% of the lead caregivers hold a university-level degree in ECEC, whereas nearly 70% of the lead caregivers had no such qualification. Within the latter group, 27% of the lead caregivers had as the highest level of education an upper secondary school diploma, 34% had a lower secondary school diploma, and 8% attended elementary school. The majority of the lead caregivers (58%) reported attending some kind of training in the last 12 months, including short courses and in-service workshops. Regarding the in-service workshops, the average hours of the training was 65 h ( $SD = 48.30$ ), ranging from 24 to 250 h, and its content was either related to health and safety issues or child development. Regarding the qualifications of the assistant caregivers, the vast majority had either an upper secondary school diploma (41%) or a lower secondary school diploma (31%).

Table 1 also provides information at the classroom level, considering the qualifications of the multiple caregivers within a classroom. Overall, 42 classrooms (47%) had one caregiver who hold a university-level degree in ECEC. In 28 classrooms (31%), the caregiver with specific ECEC qualification was the lead teacher, and in half of these classrooms (15.6%) this caregiver was assigned to more than one classroom, and thus there was daily discontinuity of the caregiving with these teachers allocating time to other classrooms besides the infant one. In a similar percentage of classrooms (15.6%), the caregiver with specific ECEC qualification was not the lead teacher, but provided some support to the infant classroom, all but one not permanently assigned to the classroom.

### **Lead caregiver: pre-service education, in-service workshops and process quality**

To examine the effects of caregiver qualifications and in-service training on process quality, we first considered the lead caregiver. We also examined a set of selected characteristics for classrooms with lead teachers with specific university-level ECEC qualification and lead teachers with no specific ECEC training, which are presented in Table 3. With regard to the workshops, 32% of qualified lead caregivers and 40% of lead caregivers with no specific ECEC qualification attended in-service workshops,  $\chi^2(1) = 0.50$ ,  $p = 0.632$ , although the lead caregivers with no qualification attended more hours,  $t(29) = 2.543$ ,  $p = 0.017$ . There were no differences in teaching experience or classroom reported ratio between the two groups, although qualified teachers earned higher salaries than caregivers with no qualification,  $t(86) = 4.15$ ,  $p < 0.001$  and worked fewer hours per week (nearly 36 h). Also, qualified teachers reported having more time for planning, with an average of nearly 3 h per week,  $t(87) = 7.23$ ,  $p < 0.001$ , and less time to work directly with children (nearly 33 h) compared to lead caregivers with no specific qualification in ECEC, whose 38 working hours per week corresponded almost entirely to time spent interacting directly with children. Similarly, qualified lead teachers were more likely to make written plans, compared to lead caregivers with no specific qualification in ECEC,  $\chi^2(1) = 23.22$ ,  $p < 0.001$ .

Next, through the use of GLM univariate analysis, we examined whether the highest level of education or attending workshops were related to observed classroom quality, as well

**Table 3.** Selected caregiver characteristics, in-service training and observed process quality by lead caregiver qualifications.

	Lead caregiver with no qualification ( <i>n</i> = 62)		Lead caregiver with specialised qualification in ECEC ( <i>n</i> = 28)		Effect size Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
In-service training					
Workshops	40%		32%		
Hours of the workshops	74.23	54.55	43.56	13.71	0.68
Caregiver characteristics					
Teaching experience	9.10	6.80	6.76	5.60	0.37
Caregiver salary <sup>a</sup>	2.00	0.48	5.63	3.30	1.90
Working hours/week	38.49	1.99	36.36	2.22	1.04
Time for working with children/week	38.29	2.29	33.22	2.89	2.06
Time for planning/week	0.04	0.32	2.73	2.89	1.22
Written planning	33%		86%		
Classroom reported infant:adult ratio	2.58	0.94	2.26	0.95	
Process quality					
Relational Climate	4.53	0.78	4.82	0.70	0.39
Teacher Sensitivity	4.04	0.85	4.51	0.89	0.55
Facilitated Exploration	2.44	0.67	2.91	0.81	0.66
Early Language Support	2.43	0.65	3.06	0.81	0.91

<sup>a</sup>Caregiver salary was coded in categories defined in 99€ intervals from 1 (= less than 481€) to 15 (= 1781–1880€).

as whether there were any significant interaction effects between the two variables. Means and standard deviations in the CLASS dimensions for classrooms with a lead caregiver holding a university-level degree in ECEC and classrooms with no trained lead caregiver are provided in Table 3. In classrooms with a lead teacher holding a university-level degree in ECEC, Facilitated Exploration and Early Language Support tended to be higher than in classrooms with no trained lead caregiver, respectively,  $F(1,79) = 4.01$ ,  $p = 0.049$ , and  $F = 9.73$ ,  $p = 0.003$ . No main effects of attending workshops were found, but the interaction effect was statistically significant for Facilitated Exploration,  $F = 5.57$ ,  $p = 0.021$ . In the subset of lead caregivers with no qualification, those who had attended workshops had classrooms with higher levels of Facilitated Exploration ( $M = 2.78$ ,  $SD = 0.62$ ) compared to classrooms in which caregivers did not attend workshops ( $M = 2.26$ ,  $SD = 0.67$ ).

### **Qualifications of the multiple caregivers: multivariate regression models predicting classroom quality from caregivers' qualifications**

Next, we computed a set of models examining the effect of the qualifications of the multiple caregivers within a classroom on process quality. Associations are presented in Table 2. The infant:adult ratio actually observed during observations was used, because it was negatively related to several variables of interest, including the CLASS dimension Facilitated Exploration ( $r = -0.22$ ,  $p < 0.05$ ), and the classroom-composite variables referring to the qualifications of the multiple caregivers, with correlations ranging from  $r = -0.26$  to  $r = -0.30$ . Note that the observed ratio represents the number of children per adult who were present the day the observations were conducted, and although moderately correlated

to the reported ratio ( $r = 0.51, p < 0.001$ ), there is considerable variation between the two variables, indicating that the daily numbers of children and/or adults can vary from the professed numbers.

A series of multivariate regression models were computed using three different classroom-level predictors, computed as previously described from the most inclusive criterion to the more restrictive, considering the caregiver's role and whether the caregiver was permanently assigned to the classroom. Model fit of the three models was compared.

Table 4 displays the summary of the results, listing the unstandardised regression coefficients, standard errors and model fit indexes. Model 1 tested the main effects of any caregiver with formal education in ECEC within the classroom. After controlling for observed ratio, analyses revealed that specialised qualification was positively associated with Early Language Support,  $b = 0.50, SE b = 0.16, p < 0.05, R^2 = 0.10$ . The AIC for this model was 652.23. Model 2 tested the main effects of the lead teachers with qualifications in ECEC. This indicator was also positively associated with Early Language Support,  $b = 0.66, SE b = 0.17, p < 0.05, R^2 = 0.15$ , as well as Facilitated Exploration,  $b = 0.41, SE = 0.17, p < 0.05, R^2 = 0.11$ , after controlling for observed ratio. Analyses also revealed a marginally significant effect for Teacher Sensitivity,  $b = 0.39, SE b = 0.20, p = 0.056, R^2 = 0.07$ . AIC for this model was 648.05, lower than that of the previous model.

Model 3 tested the main effects of the most restrictive criterion regarding formal education (i.e. lead teachers with formal education in ECEC and permanently assigned to the classroom). This indicator was positively associated with Facilitated Exploration,  $b = 0.48, SE b = 0.22, p < 0.05, R^2 = 0.10$ , and Early Language Support,  $b = 0.45, SE b = 0.23, p < .05, R^2 = 0.05$ , after controlling for observed ratio. The AIC for this model was 658.84, which was higher than those of the previous models, suggesting a worse fit. Based on these results, of the three indicators, the variability in the CLASS infant scores was better explained by model two, specialised qualification in ECEC of the lead teacher, whether or not she was permanently assigned to the infant classroom.

## Discussion

The current study examined the quality of caregiver–child interactions in Portuguese infant classrooms and its association with caregiver qualifications in ECEC. Expanding previous research, this study included formal education and in-service training of the lead caregivers, but also the qualifications of all caregivers in the infant classroom, considering their role and assignment exclusively to the infant classroom or to more than one classroom.

The CLASS–Infant (Hamre et al. 2014) was used to measure the quality of caregiver–infants interactions, reporting four dimensions of adult–child classroom interactions. Despite the positive high correlations between the four dimensions, mean scores for Relational Climate and Teacher Sensitivity were in the medium range of quality whereas the average scores for Facilitated Exploration and Early Language Support were in the low range. These results indicate that relationships between caregivers and infants were generally positive and close, and indicate that caregivers were relatively sensitive and responsive, showing consistent awareness of infants' needs and emotions. However, the low scores found in the latter two dimensions indicate that caregivers provided few opportunities to facilitate and expand infants' physical, cognitive and social exploration, or to support or expand language and communication. A similar pattern has been found in other studies in infant and toddler

**Table 4.** Summary of multivariate regression models.

	Relational Climate			Teacher Sensitivity			Facilitated Exploration			Early Language Support			
	<i>b</i>	SE	<i>R</i> <sup>2</sup>	<i>b</i>	SE	<i>R</i> <sup>2</sup>	<i>b</i>	SE	<i>R</i> <sup>2</sup>	<i>b</i>	SE	<i>R</i> <sup>2</sup>	AIC
<b>Model 1</b>													
Qualified lead/assistant caregiver	0.17	0.17	0.01	0.33	0.19	0.07	0.23	0.16	0.07	0.50*	0.16	0.10	652.2
Observed in-fant:adult ratio	-0.15	0.09		-0.15	0.11		0.03	0.09		0.03	0.09		
<b>Model 2</b>													
Qualified lead caregiver	0.29	0.18	0.03	0.39 <sup>†</sup>	0.20	0.07	0.41*	0.17	0.11	0.66*	0.17	0.15	648.1
Observed in-fant:adult ratio	-0.01	0.10		-0.14	0.11		-0.12	0.09		0.06	0.09		
<b>Model 3</b>													
Qualified permanent lead caregiver	0.27	0.23	0.02	0.34	0.26	0.06	0.48*	0.22	0.10	0.45*	0.23	0.05	658.8
Observed in-fant:adult ratio	-0.02	0.10		-0.15	0.11		-0.13	0.09		0.01	0.10		

<sup>†</sup>*p* < 0.10.

\**p* < 0.05.

classrooms. In infant classrooms in the US, Jamison et al. (2014) reported the highest mean scores for Teacher Sensitivity and Relational Climate. Lower scores were obtained for Facilitated Exploration and Early Language Support, although with higher mean scores than in the present study. Our results are also consistent with results from studies in the USA and in the Netherlands, using the CLASS–Toddler version, which reported higher average scores in emotional and behavioural support than for educational support (LaParo, Williamson, and Hatfield 2014; Slot et al. 2015).

Such results seem to indicate that caregivers are generally more effective in responding to children's social-emotional and physical needs than in other components of interactions that may imply more intentionality. Planning or expanding experiences that support infants' exploration and communication, both in play activities and in personal care routines, may be more demanding for caregivers. Specialised qualification in ECEC seems to make a difference in such components of caregiver–infant interactions. Results from the current study show that having a lead teacher with a university specialised degree in ECEC, either permanently assigned to the classroom or not, was associated with higher quality in the Facilitated Exploration and Early Language Support dimensions. It seems that providing opportunities for children to develop language and cognitive skills through interactions may require specialised knowledge and expertise. A possible explanation for our results is that holding a specialised education may contribute to more complex and multifaceted ideas about infants and their linguistic and cognitive development (Degotardi 2010). The provision of theoretical knowledge about children and opportunities for supervised pre-service practicum in ECEC university-level education appears to support caregivers to be more knowledgeable about child development and more intentional while playing with and taking care of infants. It thus seems that increasing caregivers' pre-service training may facilitate their intentionality, improving the type, amount, richness and depth of linguistic and cognitive interactions that they provide.

Of note is that Relational Climate appeared to be equally assured by qualified and non-qualified caregivers. Showing positive relational behaviours, such as proximity and smiling, seemed not to be dependent on the specialised education in ECEC. One possible explanation is that positive relationships may be considered central by all caregivers. A recent study regarding teacher ideas on teacher–child interactions in Italy, the Netherlands, and Portugal pointed out that warm and close relationships are highly valued by all caregivers (Pastori, Mantovani, and Braga 2016). It appears that the social and emotional components of relationships are considered crucial and intrinsically valued by the caregivers. Barros and Leal (2014) found that quality of teacher–child relations, characterised by positive interactions, smiling, frequent positive physical contact and relaxing and calm environment, was perceived by Portuguese caregivers and assistant caregivers as one of the most important indicators of quality in toddler classrooms. Therefore, developing a positive emotional climate may have underlying cultural values that help sustain positive interactions.

Although in this study the average scores for Relational Climate were higher than those found for Facilitated Exploration and Early Language Support, they were in the medium range of quality, suggesting that there is still room for improvement. Furthermore, the lack of associations between specialised education and Relational Climate may also be due to the specific kind of specialised education programmes attended by caregivers. Formosinho and Formosinho (2008) noted that current pre-service programmes privilege academic content and planning of academic-oriented activities with few opportunities to practice high-quality

social interactions. Such education programmes might contribute to some extent to qualified teachers' increased knowledge about how to support learning and cognitive development, but might not be enough to help them intentionally express more positive affect and demonstrate more respect when interacting with infants than non-qualified caregivers. The kind of specialised education in Portugal may also explain the marginally statistical significant associations between Teacher Sensitivity and specialised pre-service education. On the one hand, greater knowledge of child development might contribute to more accurate interpretation of infant cues; on the other hand, the limited time allocated to supervised practice with children (Formosinho and Formosinho 2008) may limit the opportunity to learn how to read infant signs and to respond appropriately and contingently. Prior research has shown that targeted training interventions closely linked to classroom practice and focused on caregiver–child interactions can be effective in improving caregiver interaction skills (Hamre et al. 2012; Werner et al. 2015). Clearly, further research that would address the type and content of pre-service education would elucidate the reasons underlying the differential effects of specialised training on CLASS dimensions.

It is also important to note that there were important differences in the working conditions and time allocated for planning between qualified and non-qualified lead caregivers which might help explain the association between qualifications and process quality. Time for planning may help lead teachers to be more intentional in their practices, as they have more time to reflect upon their own practices and child developmental assets and needs. Better working conditions may be related to more job satisfaction and sense of self-efficacy that may contribute to the quality of interactions (Goelman et al. 2006; OECD 2015; Whitebook, Howes, and Phillips 1989). Additionally, in the subset of non-qualified lead caregivers, attending workshops was associated with higher levels of Facilitated Exploration. It seems promising that in-service training can support caregivers in the provision of more stimulating interactions.

In the present study one of the most important findings was that having a university-trained lead teacher in the infant classrooms, either permanently assigned to the classroom or to more classrooms, was the most powerful predictor of caregiver–infant interactions. Our results are consistent with prior research suggesting that specific qualifications in ECEC can be important for higher quality interactions (Castle et al. 2016; Pianta et al. 2005). In addition, results from this study expand the existing literature by suggesting the important role of the lead teacher for overall classroom levels of adult–child interactions. An important result from the present study is that, although specialised qualification in ECEC was positively associated with the quality of interactions, it was the combination of specialised education and assuming responsibility over the group (i.e. being a lead teacher) that explained greater variance on the outcomes. The presence of a trained lead teacher at the crèche, even one with responsibility for two or more classrooms, seems to support the quality of interactions of all staff in infant classrooms.

A possible explanation for our results is that, when a qualified lead teacher is in the classroom for a limited period of time, her role includes not only direct interactions with infants but also supervision and support to the other caregivers. It is important to note, as previously mentioned, that the lead qualified teacher is legally responsible for organising and developing activities to promote child development, in contrast to the assistant caregivers whose officially defined responsibilities are related to providing support in those activities and routine care, and thus do not include planning.

In addition to decisions over schedules, pace and type of activities, the lead qualified teacher may act as a role model for the other caregivers and may also be considered a ‘coach.’ The lead teacher may contribute to the quality of interactions of all staff either formally, through meetings and planning, or informally, through observation, conversations and role modelling. The importance of informal supervision and teamwork has been recently highlighted as an important component of professional development (Jensen and Iannone 2015). In a recent Dutch study (Slot et al. 2015), a range of professional development activities was addressed, including more conventional forms (e.g. in-training service) to less studied ones (e.g. collaborative work or team-based reading of professional literature), and found positive associations between these professional development activities and emotional and educational process quality (assessed via the CLASS–toddler tool). It is also possible that the assistant caregivers, even if better prepared to interact appropriately with children, may feel that they have not power enough to exert influence, and team work enables them to actually implement what they know and learn. Although this explanation is speculative, the results from the present study add to the existing literature by suggesting that the interpretation of the effects of pre-service education on the teacher–child interaction quality can be enlightened by consideration of the role and responsibility of the caregivers and examination of interpersonal influences and dynamics among all staff members.

### *Limitations and future considerations*

Challenges in research on the effects of caregiver education and training on ECEC quality include lack of specification or sensitivity in the measures and variables used to document caregiver education and training, as well as on what is defined as ‘training’ and ‘education.’ In the present study, the variables used to measure caregiver education made it possible to draw inferences regarding specialised education (holding a university degree in ECEC), while also considering the caregiver’s role regarding more direct or indirect contact with children (lead caregiver or not), as well as the daily continuity (permanently assigned to one class or more than one). However, other relevant aspects, such as the full range of professional development activities, and the contents of the specialised education (e.g. including knowledge on infant and toddler development) were not included in the measures of caregiver education and in-service training.

Cho (2016) highlighted the need for research to identify, classify and define core concepts related to teacher preparation and core elements of each concept in order to fill the existing gap in our knowledge regarding aspects such as what constitutes quality of teacher education programmes and their relationship to the quality of services provided.

Another important limitation of the study is that the score for process quality is based on the behaviours of all adults in the classroom, and weighed by the amount of time and the number of children they interacted with, however the classroom-level caregiver qualification scores used all adults in the classroom but not weighted in a similar way. Setodji, Le, and Schaack (2012) showed a refined method of measurement of staff qualifications by computing a score that represents the likelihood of time a child spends with a qualified teacher in the classroom. This would have been an interesting approach.

In order to overcome previously mentioned difficulties in comparing results across studies due to differences in data sources (e.g. sample characteristics) and in research methods (IOM and NRC 2012), future research needs sound methodological designs including large

and randomly defined samples, control or comparison groups, with specific and aligned measures across variables (Burchinal, Kainz, and Cai 2011).

Another need is to further investigate the relationship between the specific content of curricula for specialised teacher education in ECEC and various aspects of teacher–child interactions and related variables, such as teacher beliefs, observed practices and child outcomes. Aspects regarding ECEC professionals’ career trajectories, such as commitment, professional development, teamwork, organisational climate and informal support should also be considered in future studies to inform stakeholders in producing collective and coordinated efforts. In sum, further research is needed to clarify the specific content of caregiver training that may be used to guide the development of more effective training, a pivotal challenge facing the area of ECEC (Martinez-Beck and Zaslow 2006).

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