Original Article

Peer Group Age Composition

Associations With Children's Engagement in Childcare

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Abstract: This observational study investigated associations between classroom age composition and 3-year-olds' engagement in Swiss mixed-age childcare, accounting for multiple contextual and individual factors. Using the inCLASS tool, observers rated 3-year-olds' engagement with caregivers, peers, and tasks across 407 observation cycles with 54 children. Situational age composition was operationalized by four indicators: peer group age range, median age, number of infants (<18 months), and number of children older than 4 years per cycle. Multilevel structural equation models revealed no significant associations between age-composition indicators and engagement quality. Thus, age differences neither advantaged nor disadvantaged children's social behavior in childcare. Instead, situational activity setting, group size, number of caregivers, and peer group stability emerged as significant predictors of engagement. Social skills and child sex were also linked to observed behavior. We discuss why prior findings on age composition are mixed and highlight the need for further evidence on how mixed-age contexts shape early social and learning outcomes.

Keywords: childcare, mixed-age classrooms, age composition, child engagement, behavioral observations

Alterszusammensetzung der Peergruppe. Zusammenhänge mit dem Engagement von Kindern in Kindertagesstätten

Zusammenfassung: Diese Beobachtungsstudie untersuchte Zusammenhänge zwischen der Alterszusammensetzung von Peergruppen und dem Engagement dreijähriger Kinder in altersgemischten Betreuungssettings in der Schweiz, unter Berücksichtigung relevanter kontextueller und individueller Faktoren. Mithilfe des Beobachtungsinstruments inCLASS wurde das Engagement von *N*=54 Kindern in *N*=407 Beobachtungszyklen in Interaktionen mit Fachpersonen, Peers sowie bei Aufgaben und Aktivitäten erfasst. Die situative Alterszusammensetzung wurde durch vier Indikatoren operationalisiert: Altersrange der Peer-Gruppe, Medianalter, Anzahl der Säuglinge (<18 Monate) und Anzahl der Kinder über vier Jahren pro Zyklus. Mehrebenen-Strukturgleichungsmodelle ergaben keine signifikanten Zusammenhänge zwischen diesen Altersindikatoren und der Interaktionsqualität der Kinder. Somit erwies sich die Altersmischung weder als förderlich noch als hinderlich für das Sozialverhalten Dreijähriger im Alltag. Die Aktivitätsform, Gruppengrösse, Anzahl anwesender Betreuungspersonen und die Stabilität der Peergruppe erwiesen sich jedoch als signifikante Prädiktoren des kindlichen Engagements. Auch soziale Kompetenzen und das Geschlecht der Kinder standen in Zusammenhang mit dem beobachteten Verhalten. Die Studie diskutiert mögliche Erklärungsansätze für bisher uneinheitliche Befunde und unterstreicht die Notwendigkeit weiterer Forschung.

Schlüsselwörter: familienergänzende Kinderbetreuung, Altersgemischte Gruppen, Alterszusammensetzung, Qualität der Interaktionen, Verhaltensbeobachtung

Early social experiences with adults and peers are foundational for children's healthy development. Prior research has highlighted the role of early relationships in fostering socio-emotional development and learning (Howes & James, 2002; Ladd, 2005; Pianta, 1999). In childcare settings, the nature and quality of children's interactions with caregivers, peers, and learning-related activities have been identified as central to linking early educational experiences to developmental outcomes (Booren et al., 2012; Kim et al., 2019; Rojas & Abenavoli, 2021; Sabol et al., 2018; Williford et al., 2013).

In the present study, *engagement* refers to children's active, sustained participation and responsiveness across social and learning contexts, including interactions with caregivers, peers, and classroom activities (Downer et al., 2010, 2011). Consistent with the conceptual framework of the Individualized Classroom Assessment Scoring System (inCLASS), engagement is assessed through direct observation of children's behavior in naturally occurring class-

room contexts. Rather than capturing isolated behaviors or decontextualized traits, the inCLASS focuses on global patterns of children's interactional functioning as they respond to contextual supports, constraints, and challenges (Downer et al., 2010). From this perspective, engagement reflects how children's socio-emotional and regulatory competencies become visible in ongoing interactions. These competencies shape how children initiate, maintain, and regulate exchanges with others and with tasks. At the same time, repeated engagement in such interactions constitutes a central pathway through which competencies are further strengthened and differentiated over time. In line with the bioecological model of development (Bronfenbrenner & Morris, 1998), engagement can thus be understood as a proximal process unfolding within everyday classroom experiences.

Prior research has shown that the nature and quality of caregiver-related behavior as well as children's connection and positive engagement with caregivers are among the strongest predictors of children's concurrent and later achievement and social competence (Curby et al., 2013, 2014; Howes, 2000; Kim et al., 2019; Williford et al., 2013; Wilson et al., 2007). Within the inCLASS framework, indicators of engagement with teachers include observable behaviors such as initiating communication, expressing positive emotions, and using the teacher as a source of help and support (Downer et al., 2010, 2011). Peers constitute an equally important part of the early social environment. In Swiss childcare settings, even 8-month-old infants engage in peer interactions during approximately 50 % of observed social interactions, with peer engagement increasing significantly with age (Simoni et al., 2015). Through play and shared activities, young children develop skills essential for forming positive peer relationships and supporting cognitive and socio-emotional development (Fabes, Hanish et al., 2003; Kim et al., 2019; Ladd & Sechler, 2012; Ladd & Troop Gordon, 2003; Williford et al., 2013). Indicators of peer engagement include the child's positive emotions and behaviors toward other children, the tendency to seek peer interactions, social awareness, and sharing or collaborating during play and learning activities (Downer et al., 2010, 2011). Engagement with tasks refers to children's ability to remain involved in activities, regulate their behavior in response to situational demands, and make constructive use of learning opportunities (Downer et al., 2010, 2011; Kim et al., 2019).

The present observational study investigated behavioral indicators of children's engagement with caregivers, peers, and tasks, with a specific focus on the role of peer group age composition. We examined interactions of 3-year-olds in naturally occurring mixed-age childcare settings.

Age Composition in Childcare

Peer-group age composition is increasingly recognized as a meaningful dimension of childcare quality: Both theoretical concepts and empirical evidence suggest that the ages of peers with whom children interact may contribute to developmental trajectories. Nonetheless, compared to other quality indicators, age composition has been understudied, with findings remain inconsistent across variables studied, methodology, and cultural context.

Early research mainly contrasted mixed-age versus same-age groupings, reporting benefits of mixed-age settings for children's socio-emotional and cognitive gains (Field, 1982; Fosco et al., 2004; Goldman, 1981; Gray, 2011; Graziano et al., 1976; Kadivar et al., 2005; Logue, 2006; McClellan & Kinsey, 1999). In line with Vygotsky's (1978) and Bandura's social learning theory (Bandura, 1986), these benefits are most relevant for younger children, who learn and foster their competencies through observing and interacting with more advanced and skilled children. Supporting this, research has shown that toddlers aged 18–24 months were more socially involved when paired with an older peer than with a same-age peer (Brownell, 1990). Interactions with older or more skilled peers have also been associated with more complex cognitive play (Dunn et al., 1996) and more social pretend play among 2- to 4-year-olds (Howes & Farver, 1987; Jaggy et al., 2020). Some research has reported reciprocal advantages for older children who gain leadership and nurturing experiences in mixed-age groups (for a review, see Gray, 2011). For instance, Derscheid (1997) found that older preschoolers in mixed-age settings showed higher levels of helping behavior and perspective-taking toward younger peers, suggesting benefits in the domain of sociomoral development. Katz et al. (1990) argued that mixed-age settings provide older children with opportunities for leadership, peer tutoring, and adaptive social interactions, allowing them to adjust their behavior and communication to the needs of younger peers and thereby strengthen prosocial and cognitive skills.

However, other studies have found no clear benefits or even disadvantages of mixed-age arrangements (for a review, see Veenman, 1995). For example, Bailey et al. (1993) found no significant differences in the amount or type of social play between toddlers in mixed-age and same-age groups, suggesting that age composition did not substantially influence children's social behavior in their sample. Winsler et al. (2002) have shown that in age-homogeneous classrooms, 4-year-olds were more goal-directed, showed more sustained attention to task activities, spent more time interacting with peers, and less time interacting with teachers compared to 3-year-olds. These age-related developmental differences were reduced in

mixed-age classrooms, where children of different ages behaved more similarly. Interactions with younger and same-age peers were linked to less complex social and cognitive play and lower receptive language scores in family childcare homes (Dunn et al., 1996).

More recent work has moved beyond simple comparisons of mixed-age and same-age groupings and has examined more specific components of age composition in childcare. One such component is the *mean age* of the children present. Aarts et al. (2016), for example, found that a higher mean age within mixed-age (0–4 years) and preschool (2–4 years) groups was associated with better group functioning, defined as mutual connection between children and the presence of positive emotions in peer interactions. By contrast, studies by Sundell (1994a, 1994b, 2000) identified the *age range* as a relevant predictor of developmental outcomes: A wide age range was associated with lower verbal and cognitive achievements, negative peer-directed behavior, and negative peer nominations in 3- to 5-year-olds. Furthermore, Moller et al. (2008) demonstrated that both the group's chronological age composition (i.e., the age range and the standard deviation of age in a class) and the variance in developmental age (i.e., children's baseline ability) were negatively related to children's cognitive, motor, and social skills. The results also suggested that such negative effects were stronger for children who were older in developmental age, indicating that discrepancies between children's developmental level and the group's age composition may limit participation in age-appropriate activities, negatively affecting learning opportunities and social adjustment. Another important factor is the *proportion of very young children*, such as infants and toddlers, in the group. Several studies have shown that a higher number of younger children negatively affects the quality of caregiving interactions (de Schipper et al., 2007; Sommer & Sechtig, 2016). This is likely because very young children require more direct emotional support, physical care, and attention (e.g., feeding, comforting, sleeping routines), which can interrupt structured or interactive activities with older children (Diebold & Perren, 2020).

Taken together, these findings suggest that moderate age diversity can foster children's development – especially among the youngest – while extreme age differences within a group, in particular the inclusion of very young children, may complicate caregiving and teaching tasks, such as giving instructions, managing behavior, or offering developmentally appropriate learning opportunities. In turn, these challenges may negatively affect children's developmental outcomes.

Childcare in the Swiss Context

In Switzerland, these complexities are particularly relevant due to the distinctive organization of the childcare system. Children from the end of maternity leave (around 4 months) up to school entry (around 6 years of age) are typically grouped together in mixed-age settings, with approximately 37 % of children under age 4 attending formal childcare (Bundesamt für Statistik, 2024). Swiss childcare is also highly flexible, allowing families to tailor attendance schedules to their work needs. As a result, a single childcare slot may be shared by multiple children (e.g., one in the morning, another in the afternoon), and attendance ranges from 1 to 5 days per week, for just a few hours or a full day. In practice, older children – such as those in kindergarten or even primary school – often join for lunch or during school holidays, further increasing age heterogeneity. This fluidity means that the group's mean age, age range, and the number of infants or older peers present can fluctuate daily (or even hourly), potentially affecting both caregiving and individual child behavior.

These unique structural and organizational characteristics make Swiss childcare a particularly dynamic context for studying age composition. Rather than focusing on static group metrics (e.g., official group size), it becomes essential to consider *situational age composition* – the specific age makeup of the peer group at the specific moment a child is engaged in an activity. Prior research in Swiss childcare context has shown that such situational features can be stronger predictors of caregiver–child interaction quality than general structural indicators (Diebold & Perren, 2020; Reyhing et al., 2019).

The Present Study

The present study aimed to investigate how situational peer group age composition relates to 3-year-olds' observed engagement with caregivers, peers, and tasks. Age composition is a multifaceted construct; building on prior research and the distinctive features of Swiss childcare, we examined several situational indicators: the group's *age range*, its *mean age*, and the *number of infants* and *children older than 4* present at a given moment – to explore whether exposure to younger and older peers is beneficial or disadvantageous for children's behavior. While most children leave childcare before the age of 5, older children may still be present during school holidays or lunchtime, ensuring sufficient variation in peer-age exposure.

Covariates

We also considered other childcare-related and individual factors that may contribute to child engagement in pre-

school settings. First, we accounted for activity settings, as studies using inCLASS have shown that children's engagement varies by context: Positive peer interactions are more frequent during free-choice activities, while teacher-guided activities promote more interactions with caregivers (Booren et al., 2012; Smidt & Embacher, 2020; Vitiello et al., 2012; Yoder et al., 2019). Second, we controlled for the number of caregivers present and situational group size, both of which are important structural quality characteristics (Cryer et al., 1999; Phillips et al., 2000; Reyhing et al., 2019). We also included group stability, defined as the number of days per week children attend together, given that fluctuating attendance is common in Switzerland due to family-oriented scheduling. Finally, we controlled for child age, sex, and sociability (i.e., the ability to initiate social interactions), as previous research has highlighted the importance of social skills for the quality of peer engagement (Diebold & Perren, 2022).

Method

Study Participants and Procedure

A total of 185 children (M = 3.10 years, SD = 1.28; age range = 4 months to 6 years) from nine groups in four German-speaking Swiss childcare centers participated in the study. This wide age range reflects the typical mixed-age structure of Swiss childcare. Childcare centers were recruited via email and follow-up phone calls. After obtaining the agreement of childcare directors for study participation, all parents were informed in writing about the study's goals, procedures, and schedule.

Only children aged 30 months or older were eligible to be selected as focal children for individual observation. For these children (N = 54, 46% female, M = 3.50 years, SD = 0.50), parents provided additional active consent and were informed that participation could be withdrawn at any time without any consequences. Focal children attended childcare at least 2 days per week and were observed for their individual engagement in classroom activities over two separate mornings by certified observers, with each child rated multiple times per visit.

Following the observation period, primary caregivers completed questionnaires for each focal child, either online or via paper–pencil format.

Study Measures

Observation of Child Engagement

Children's engagement in childcare was assessed using the Individualized Classroom Assessment Scoring System (inCLASS: Pre-K; Downer et al., 2011). This child-focused observational tool captures both positive and negative engagement with caregivers, peers, and tasks within a specific moment, that is, related to situational context and interaction partner. It comprises 10 dimensions, organized into four domains: *Positive Engagement With Teachers* (Teacher Engagement, Teacher Communication), *Positive Engagement With Peers* (Peer Sociability, Peer Communication, Peer Assertiveness), *Positive Task Engagement* (Engagement Within Tasks, Self-Reliance), and *Negative Engagement* (Teacher Conflict, Peer Conflict, Behavior Control; Downer et al., 2011). Each dimension was rated on a 7-point scale (1 = *low* to 7 = *high*), with higher values indicating more frequent and positive engagement, except for conflict dimensions, where higher scores reflect more negative behavior.

Observations followed standard inCLASS procedures: eight 10-min cycles (four per day on 2 days) were conducted for each child ($N_{\text{total observation cycles}}$ = 407). Observers first completed training and passed a reliability test. Interrater reliability was then assessed via double coding of 87 cycles and yielded excellent agreement (ICC = .87; range = .71–.94). Internal consistency was high for the positive engagement domains (α = .80 for Teacher Engagement and α = .91 for Peer Engagement), but low for negative engagement (α = .43), likely due to floor effects. Less than 1% of Teacher Conflict and only about 3% of Peer Conflict observations fell into the mid-range (Codes 3 or 4), suggesting a very low level of negative interactions between focal children and their caregivers and peers. Because of this low variance, only the three positive engagement domains were included in subsequent analyses. Dimension scores were averaged per cycle, and domain scores were computed accordingly.

Assessment of Age Composition

To assess situational peer group age composition, observers documented the names of all children present for the majority of each inCLASS observation cycle. Following the inCLASS manual, presence was defined as children who were in the room or in the specific classroom area that the focal child could have interacted with (i.e., the potential interaction partners for the focal child). These name lists were compiled for every observation cycle and were used to compute situational group metrics (group age range, median age, and counts of children aged < 18 months and > 48 months), ensuring that the operationa-

lization of age composition was spatially and temporally aligned with the inCLASS observation windows.

Assessment of Other Childcare-Related and Individual Characteristics

Children's social skills were assessed using a subscale of the SOCOMP questionnaire (*S*elf- and *O*ther-Oriented Social *Comp*etences; Perren, 2007), completed by playgroup educators. Based on findings that sociable and assertive children engage more positively with peers (Diebold & Perren, 2022), we focused on self-oriented social skills, captured by three subscales: *leadership* (e.g., "organizes, suggests play activities"; α = .79), *setting limits* (e.g., "refuses unreasonable requests"; α = .79), and *social participation* (e.g., "outgoing in peer group"; α = .79). Items were rated on a 3-point scale (0 = *not at all true* to 2 = *definitely true*). In contrast to observed behavior, these ratings reflect stable individual traits that are independent of specific situations (Diebold & Perren, 2022; Groeben et al., 2011).

Childcare directors additionally provided information on each child's sex, birthdate, and attendance during the observation week. This information was used to calculate *group stability*, defined as the proportion of days during the week that children attended together more than once. The calculation was based on the Stability Measurement Tool (Pennings & Meij, 2012) and reflects the flexible structure of Swiss childcare. Stability scores ranged from 0 % to 100 %, with higher values indicating a greater proportion of days per week that children attended the group together, and thus greater group stability. At each observation cycle, observers also recorded the *activity setting*, using categories adapted from Ritchie et al. (2001): teacher-guided activity, free choice, meals, and transitions (see Table A1 in Appendix A), along with the number of children and caregivers present.

Data Analysis

Given the study's focus on situational peer group age composition, analyses were conducted at the observation cycle level rather than computing mean scores for each child. The data had a multilevel structure, with cycles nested within children, who were nested within childcare groups. Multilevel structural equation modeling (MSEM) was conducted using Mplus 7.31 (Muthén & Muthén, 2012).

Variance Components and Intra-Class Correlations

To assess the need for multilevel modeling, a three-level model was specified with observation cycles (Level 1), individual children (Level 2), and childcare groups (Level 3). As shown in Table B1 (Appendix B), most of the variance in child engagement was primarily due to within-child and between-child differences, with less than 10 % at the group level. This supported the use of two-level models, with cycles ($N_{\text{Level 1}}$ = 407) nested within children ($N_{\text{Level 2}}$ = 52) (Aguinis et al., 2013).

Main Analysis

Six models were estimated to examine associations between age composition and positive engagement (with teachers, peers, and tasks). To avoid multicollinearity, age range and median age (Models 1–3) and the number of children younger than 18 months or older than 48 months (Models 4–6) were tested separately, as these variables were interrelated.

At Level 1 (cycle level), predictors included age composition indicators, activity setting (dummy-coded, with teacher-guided activity as reference category), and the number of caregivers and children present. To assess their independent effects, these predictors were entered separately rather than combined into caregiver–child ratios. At Level 2 (child level), child age, sex, and social skills were included. Peer group stability was also modeled as a child-level predictor, based on the variance decomposition results and the small number of groups (N = 9). All continuous predictors were grand-mean centered. Each model included random intercepts and random slopes, allowing associations between predictors and engagement to vary across children. Covariances between intercepts and slopes were also estimated (Aguinis et al., 2013; Geiser, 2011).

To assess model fit and interpretability, level-specific R^2 values were computed to indicate the proportion of variance explained at each level relative to the null (intercept-only) model (LaHuis et al., 2014; Rights & Sterba, 2019). Explained variance ranged from 5.6 % to 15.8 % at the cycle level (Level 1) and from 9.8 % to 42.9 % at the child level (Level 2), depending on the engagement domain. Specifically, the models explained 5.6 % and 13.2 % of the cycle-level and child-level variance in teacher engagement, 13.3 % and 42.9 % for peer engagement, and 15.8 % and 9.8 % for task engagement (see Table B2). Positive level-specific R^2 values indicate that including the predictors increased explained variance relative to the null model. The predictors accounted for the largest proportion of variance in peer engagement at the between-child level, moderate variance in task engagement at the observation level, and modest variance in teacher engagement, particularly between children.

Table 1. Descriptive statistics for the study variables

Variable	Frequency (%)	*M*	*SD*	Range	
				Min	Max
Teacher Engagement		2.75	1.45	1.00	7.00
Peer Engagement		2.38	1.39	1.00	6.33
Task Engagement		4.91	1.00	1.00	7.00
Age range		2.58	0.86	0	4.20
Median age		3.02	0.49	1.67	4.08
Number of children < 18		0.66	0.92	0	4
Number of children > 48		1.38	1.12	0	5
Teacher-guided activity	24				
Free choice	50				
Meals	16				
Routines/transitions	16				
Number of caregivers		2.38	1.05	0	10
Group size		7.92	3.00	1	26
Child age (in months)[a]		42.80	6.20	30	53
Child sex (female)[a]	44				
Social skills[a]		2.32	0.43	1.36	3
Peer group stability		42.48	11.10	22	59

Note. Number of children < 18 = number of children younger than 18 months. Number of children > 48 = number of children older than 48 months.
[a]For the individual child variables, the values are based on person-aggregated scores.

Results

Preliminary Results

Table 1 presents descriptive statistics. Child-level averages across observation cycles indicated low to moderate levels of positive engagement with teachers ($M = 2.75$) and peers ($M = 2.38$), and moderate task engagement ($M = 4.91$), consistent with prior findings by Vitiello et al. (2012). Free-choice activities were observed most frequently (50 %), followed by teacher-guided settings (24 %). Bivariate correlations (Table 2) showed that a wider age range was significantly associated with lower task engagement ($r = -.11$, $p < .05$), and a higher peer median age was associated with lower teacher engagement ($r = -.15$, $p < .01$). Children's engagement was also linked to several control variables.

Main Analyses

Table 3 summarizes the multilevel structural equation models examining situational age composition as a predictor of 3-year-olds' positive engagement with teachers, peers, and tasks. Neither age range, nor median age, nor the counts of children younger than 18 months or older than 48 months were significantly associated with child engagement in any domain, indicating no link between peer-age composition and 3-year-olds' observed behavior.

By contrast, several covariates emerged as significant predictors. Activity setting had robust effects across all domains: Relative to teacher-guided activities, children showed lower teacher engagement during free choice ($b = -.68$, $p < .001$), meals ($b = -.55$, $p < .01$), and routines/transitions ($b = -.68$, $p < .001$); higher peer engagement during free choice ($b = .84$, $p < .001$); and greater task engagement during free choice ($b = .48$, $p < .001$) and meals ($b = .34$, $p < .05$), but lower task engagement during routines/transitions ($b = -.45$, $p < .01$). The number of children and the number of caregivers present were both significantly associated with child engagement. A greater number of children (i. e., bigger group size) was linked to lower teacher engagement ($b = -0.13$, $p < .01$). The number of caregivers present was negatively associated with peer engagement ($b = -0.20$, $p < .01$) and with task engagement ($b = -0.13$, $p < .10$), but showed no significant association with teacher engagement.

Among child-level factors, boys exhibited more positive peer engagement than girls ($b = .38$, $p < .05$), and higher self-oriented social skills were associated with greater engagement across all domains (teacher: $b = .43$, $p < .10$; peer: $b = .73$, $p < .01$; task: $b = .31$, $p < .10$). Finally, greater peer-group stability was modestly linked to lower peer ($b = -.02$, $p < .10$) and task engagement ($b = -.02$, $p < .05$).

Table 2. Bivariate Pearson correlations among all study variables

	Variable	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Teacher Engagement	−.14**	.11*	.00	−.15**	.03	−.07	.19***	−.15**	.00	.04	.01	−.10*	.08	−.00	.09†	−.12*
2	Peer Engagement		.28***	−.04	−.01	−.01	.04	−.22***	.32***	−.13**	−.12*	−.15**	−.09†	.10*	.11*	.23***	−.07
3	Task Engagement			−.11*	−.01	−.06	−.07	−.13**	.26***	.01	−.24***	−.22***	−.22***	.00	.06	.14**	−.07
4	Age range				−.20***	.66***	.38***	−.02	−.11*	.10†	.10†	.29***	.59***	.07	−.04	−.01†	.11*
5	Median age					−.41***	.48***	.04	.05	−.05	−.12*	−.09†	.04	.20***	−.10†	.15**	.31***
6	Number of children < 18						−.02	−.02	−.09*	.04	.17***	.07	.12*	−.04	−.03	−.17***	−.02
7	Number of children > 48							−.02	.00	.04	−.03	.12*	.38***	.30***	−.08	.06	.04
8	Teacher-guided activity								−.51***	−.22***	−.08†	.08	.05	.00	−.05	−.04	−.04
9	Free choice									−.44***	−.32***	−.20***	−.18***	−.07	.00	.05	.00
10	Meals										−.06	.15**	.14**	.00	−.03	.01	.01
11	Routines/transitions											.11*	.05	.04	.07	−.07	−.13*
12	Number of caregivers												.62***	−.04	−.09†	−.02	−.06
13	Group size													.05	−.09†	.03	.22***
14	Child age														−.09†	.22***	.15**
15	Child sex[a]															−.10*	−.13**
16	Social skills																.23***
17	Peer group stability																

Note. Number of children < 18 = number of children younger than 18 months. Number of children > 48 = number of children older than 48 months.
[a]Child sex was coded 0 for female and 1 for male.
† $p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3. Associations between age range / median age and children's engagement: results of MSEM

Predictor variable	Positive engagement with teacher		Positive engagement with peer		Positive engagement with tasks	
	B	*SD*	*B*	*SD*	*B*	*SD*
Level 1: observation cycle						
Intercept	3.235***	0.167	1.792***	0.140	4.697***	0.124
Age range	0.134	0.092	0.016	0.079	0.049	0.091
Median age	−0.271	0.191	−0.077	0.157	0.059	0.104
Activity setting[a]						
Free choice	−0.675***	0.137	0.838***	0.148	0.476***	0.130
Meals	−0.552**	0.193	0.038	0.144	0.340*	0.157
Routines/transitions	−0.679***	0.179	−0.197	0.164	−0.449**	0.175
Number of caregivers	0.081	0.106	−0.200**	0.073	−0.132†	0.073
Group size	−0.112*	0.045	0.048	0.031	−0.027	0.031
Level 2: child						
Child age	0.258	0.201	0.284	0.181	−0.023	0.125
Child sex[b]	0.018	0.197	0.372*	0.189	−0.046	0.123
Social skills	0.433†	0.256	0.731**	0.275	0.311†	0.166
Peer group stability	−0.013	0.009	−0.018†	0.010	−0.015*	0.007
Variance components						
Level 1 variance	1.549***	0.142	1.334***	0.147	0.735***	0.083
Intercept (level 2) variance	0.309**	0.103	0.225**	0.068	0.092*	0.038
Slope (level 2) variance	0.012	0.089	0.007	0.039	0.010	0.015
Intercept-slope covariance	0.023	0.065	−0.003	0.052	−0.023	0.033
ICC (level 2)	0.182	–	0.200	–	0.127	–

Note. $N_{Level\ 1}$ = 407 (observation cycles), $N_{Level\ 2}$ = 52 (children). Unstandardized coefficients are presented. ICC = single-level variance divided by total variance (the sum of variances on each nested level).
[a]Referent activity setting is teacher-guided activity. [b]Child sex was coded 0 for female and 1 for male.
† $p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

This study examined whether situational peer group age composition influences 3-year-olds' observed engagement with teachers, peers, and tasks in Swiss mixed-age childcare, accounting for other contextual and individual factors. Across multilevel models, neither age range, median age, nor the counts of infants (< 18 months) or older children (> 48 months) were associated with children's engagement. Instead, activity setting, group size, the number of caregivers, child sex, social skills, and group stability emerged as primary determinants of toddlers' positive engagement.

Associations Between Situational Age Composition and Child Engagement

Contrary to some international reports of negative effects of wide age spans (Moller et al., 2008; Sundell, 1994b, 2000) or advantages of higher mean age (Aarts et al., 2016), our moment-by-moment analyses found no association between peer-age variables and children's engagement. These null findings align with Sundell's (1994a) work in Sweden – a context similarly characterized by broad, stable mixed-age groups. Unlike experimental studies that temporarily reconfigure groups (Logue, 2006), our naturalistic design reflects ongoing peer-age variability and focuses on children's behavior in a specific situation and at a given moment rather than on long-term developmental outcomes.

Also contrary to expectations based on research linking high infant ratios to lower caregiving quality (Diebold & Perren, 2020; Curby et al., 2013, 2014; Gialamas et al., 2014; Howes, 2000; Pianta, 1999; Wilson et al., 2007) and studies suggesting benefits of younger or older playmates (Derscheid, 1997; Gray, 2011; Howes & Farver, 1987; Jaggy et al., 2020; Katz et al., 1990), we found no effects of the number of infants or older children on child engagement. These results suggest again that at a specific moment and when experiencing continuous fluctuations in peer-age composition, the sheer presence of much

younger or older peers did not influence 3-year-olds' interaction competence in children's observed behavior.

Overall, these findings suggest that when mixed-age care is routine rather than experimentally imposed, children seem to adapt fluidly to varying peer ages, and peer-age characteristics alone neither hinders nor enhances their engagement.

Associations Between Other Childcare-Related Factors and Child Engagement

In line with prior international findings, child engagement varied with actual activity setting. Group size and the number of caregivers present were also found to be associated with the observed behavior of 3-year-olds. As expected, children were involved in more positive interactions with caregivers during teacher-guided activities and in small groups. By contrast, they showed more positive peer engagement during free-choice activities and settings with fewer caregivers. Further, observers rated more task engagement during free-choice activities and meals. These findings are largely consistent with prior studies indicating that free-choice activities were positively associated with children's peer engagement, whereas teacher-led and whole-group activities were negatively related to children's interactions with peers (Smidt & Embacher, 2020; Yoder et al., 2019). Our results emphasize again that free-choice time offers children more opportunities to engage with other children and to select activities that better motivate them to persist with tasks, leading to more active and enthusiastic engagement. International comparative research further highlights that engagement patterns can vary depending on the dominant activity setting in a given preschool system (Åström, 2023). In Swedish preschools, free play is the main activity setting, with children spending considerable time outdoors and engaging in many peer interactions. By contrast, teacher-led whole-group activities are more common in Portugal and the United States. Interestingly, Åström (2023) found that children were often less engaged in their dominant activity setting, while engagement was highest in less frequent formats, such as teacher-led small groups in Sweden. On the basis of these findings, the authors conclude that changing activity settings more frequently may increase children's engagement levels. Taken together, these results suggest that the effects of free-choice versus teacher-led activities on engagement may differ depending on the broader preschool context and its typical activity structures. Finally, the lowest levels of teacher and task engagement were observed during routines and transitions, consistent with previous literature identifying these moments as particularly challenging for caregivers and children alike (Booren et al., 2012; Reyhing et al., 2019; Vitiello et al., 2012).

Although the negative association between the number of caregivers and task engagement may seem counterintuitive, several explanations are plausible. First, the high correlation between caregiver and child counts reflects generally appropriate caregiver-to-child ratios during each observation cycle: More caregivers were present when larger numbers of children were also attending. At the same time, this strong correlation may have introduced multicollinearity or suppressor effects, which could have contributed to the unexpected sign of the caregiver coefficient. Second, the activity setting might be a confounding factor in the association between caregiver number and task engagement. Higher caregiver numbers may occur more frequently during meals, routines, or transitions – contexts in which children typically show lower levels of task-oriented behavior. In addition, staff may be allocated reactively to larger or more demanding and challenging children groups, so that more caregivers coincide with situations in which child engagement is already lower. Taken together, these patterns suggest it is not the number of adults per se but how effectively they support children's attention, enthusiasm, and self-reliance during tasks and routines that matters. Quality, timing, and allocation of caregiver support are likely more decisive for sustaining active engagement than the sheer quantity of caregivers.

Unexpectedly, greater peer group stability was associated with slightly lower peer and task engagement – perhaps reflecting that dynamic group membership offers more choice of play partners, keeping interactions novel and stimulating. We further speculate that group stability may become more crucial as children age and form deeper friendships, requiring consistent peer interactions.

Associations Between Individual Characteristics and Child Engagement

Self-oriented social skills, rated by educators, predicted more positive engagement across teachers, peers, and tasks, reinforcing prior evidence on the role of individual competencies (Diebold & Perren, 2022; Kim et al., 2019). Boys displayed higher peer engagement than girls, aligning with findings on boys' greater social initiation at this age (Benenson et al., 1997; Fabes, Martin, et al., 2003; Martin & Fabes, 2001).

Strengths, Limitations, and Directions for Future Research

To our knowledge, this is the first study to link situational age composition with children's engagement in the naturally flexible, age-heterogeneous context of Swiss childcare. While our findings – that peer-age differences neither benefit nor disadvantage toddlers' engagement – are novel, conclusions remain limited by the cross-sectional design, and findings pertain specifically to 3-year-olds in Swiss settings. Further research in both Swiss and international settings is needed. Nevertheless, our study makes several important contributions in a number of respects. First, the investigation was conducted in a natural mixed-age childcare setting, rather than employing artificial or temporary group reconfigurations. Second, by leveraging Switzerland's distinctive childcare model and fine-grained observations, we could combine multiple facets of *situational* age composition, as situational characteristics have proved to be crucial factors in childcare (Diebold & Perren, 2020; Reyhing et al., 2019), and previous research has emphasized the importance of differentiating between different aspects of age composition (Diebold & Perren, 2020). Although peer age does not seem to be relevant for children's engagement, classroom age composition has been linked to caregiving quality (Diebold & Perren, 2020; Kuger & Kluczniok, 2009; Sommer & Sechtig, 2016; Sundell, 1994b), which in turn affects children's cognitive and socio-emotional outcomes (Curby et al., 2013; Gialamas et al., 2014; Howes, 2000; Pianta, 1999; Wilson et al., 2007). For example, Curby et al. (2014) demonstrated that teachers' emotional support predicts later positive engagement across domains. Longitudinal studies are therefore essential to test whether caregiving quality mediates any longer-term effects of peer-age composition on development. Key questions remain open: Do mixed-age or same-age groupings yield better outcomes, and are certain age spans particularly advantageous? Comparative studies across diverse childcare systems can address these issues. Future research should also explore whether specific peer-age configurations differentially benefit subgroups – older preschoolers, children with developmental disabilities, or high-ability children may each respond uniquely. Finally, our findings underscore the importance of child-level factors (e.g., social skills, behavioral profiles, special needs) when investigating child behavior in a childcare context. These insights can guide caregivers in organizing and facilitating activities that support diverse forms of engagement across all age groups in dynamic mixed-age settings.

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Appendix A

Table A1. Operational definitions for activity setting categories

Category	Definition
Teacher-guided activity	The child is part of an organized activity. Structured activities can include stories, songs, calendar instruction, discussion, reading books, demonstrations, as well as art projects, writing stories, collective building, cooking projects, small-group instruction etc. Such structured activities are often completely teacher led but do not have to be. The teacher decides what children should be doing and assigns children to activities, even if the teacher is not participating in the group. The activities may be instances when a teacher organizes a group activity but then does not have an active role in leading it – although rare, this would still be coded in this category.
Free choice	During this time children are able to select what and where they would like to play or learn. Activities can include individual art projects, blocks, pretend area, puzzles, reading, puppets, computer, science areas etc. The key here is that children themselves have chosen their activities. It does not matter if the activity is individual or in a small group, or with or without the teacher.
Meals	The child is eating lunch, breakfast, or snacks, or enjoying food that the class cooked during a cooking project.
Routines/ transitions	The child is part of a major transition from one activity setting to another or between routine classroom procedures; for example, moving from centers to a whole group, toileting, standing in line, cleanup time, waiting times between activities, and/or waiting for materials to be passed out.

Appendix B

Table B1. Variance components and intra-class correlations (ICCs) for inCLASS domains

	Teacher Engagement	Peer Engagement	Task Engagement
Variance components			
Level 1: cycle	1.641***	1.538***	0.873***
Level 2: child	0.356***	0.394***	0.102**
Level 3: childcare group	0.112	0.004	0.034
ICC coefficients			
Level 2: child	0.169	0.204	0.103
Level 3: childcare group	0.054	0.002	0.033

Note. ICC = single-level variance divided by total variance (the sum of variances on each nested level). $N_{Level\ 1}$ = 407 (observation cycles), $N_{Level\ 2}$ = 52 (children), $N_{Level\ 3}$ = 9 (childcare groups). *p < .05. **p < .01. ***p < .001.

Table B2. Level-specific R^2 values (with explained variance) for multilevel models of child engagement

Domain	Level 1 (observational cycle)	Level 2 (child)
Teacher Engagement	0.056 (5.6 %)	0.132 (13.2 %)
Peer Engagement	0.133 (13.3 %)	0.429 (42.9 %)
Task Engagement	0.158 (15.8 %)	0.098 (9.8 %)

Note. Level-specific R^2 values indicate the proportion of variance explained by the predictors at each level relative to the null (intercept-only) model.