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REPORT

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Teachers matter in early childhood: The relation between teacher behaviours and executive function development in toddlerhood

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Abstract

The current study investigates the role of teacher behaviors in toddlers' executive function development. Teachers' ($N = 215$) emotional and behavioral support and instructional support were observed through classroom observations when children were 2 years old. Selective attention, verbal short-term memory, and visuospatial working memory of children ($N = 876$, 48.4% female) were assessed at age 2 ($M_{age} = 28.60$ months, SD $= 2.83$) and 3 ($M_{age} = 42.38$ months, SD $= 2.47$). Teachers' instructional support positively predicted growth in selective attention, but not verbal short-term memory or visuospatial working memory. Teachers' emotional and behavioral support did not predict the growth in executive function measures. Findings have implications for understanding the role of teacher-child interactions in executive function development in toddlerhood.

KEYWORDS
executive function, teacher-child interaction, toddlerhood

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1 | INTRODUCTION

Executive Functions (EF) are a set of higher order cognitive processes which enable goal-directed actions, thoughts and emotions (Miyake et al., 2000). Many researchers agree that EF capacity is composed of three interrelated sub-components: working memory (i.e. holding information in mind and manipulating it), inhibitory control (i.e. inhibiting distractions and automatic behaviours as well as suppressing interference) and cognitive flexibility (i.e. switching between strategies and flexibly changing attentional focus) (Diamond, 2006). EF abilities are important for academic success (Brock et al., 2009; Kim et al., 2013; Mulder et al., 2017), language development (Sesma et al., 2009; Slot & von Suchodoletz, 2018) and social competence (Jacobson et al., 2011; Riggs et al., 2006). An important issue addressed in previous literature is whether and how children's EF development is impacted by their teachers (Farran & Hofer, 2012; Pianta et al., 2020). Most studies in this field focused on the effect of teacher–child interaction and classroom settings in children aged 4 years and older, namely, kindergartners (McKinnon & Blair, 2019; Vandenbroucke et al., 2018), and school-aged children (Berry, 2012; de Wilde et al., 2016). Even though toddlerhood is a crucial period for EF growth (Garon et al., 2008), to our knowledge only one study has investigated the relation between quality of teacher–child interactions and child EF at this young age (Salminen et al., 2021). The aim of the current study is to investigate whether emotional and behavioural support as well as instructional support of teachers at the age of 2 years predict the EF development of toddlers from age 2 to 3 years.

1.1 | Executive functions and their relation to teacher behaviours in early childhood

Converging evidence suggests that EF starts to develop very early (Garon et al., 2008; Garon et al., 2014; Hendry et al., 2016): Garon et al. (2008) showed that working memory, inhibitory control and shifting abilities emerge before the age of 3 years. Similarly, Hendry et al. (2016) demonstrated that building blocks of EF such as control of attention, processing speed and self-regulation emerge in the first year of life. Further, abilities related to cognitive flexibility (maintaining, updating, shifting, conflict resolution) emerge in the second year (Hendry et al., 2016). It is, however, important to note that there are differences in terms of measurement of EF between toddlers and older children. For example, selective attention, the ability to focus on stimuli while ignoring distractors, is often included in batteries measuring EF in early childhood (Posner & Rothbart, 2007; Scerif et al., 2004) because it is considered as one of the precursors of working memory and inhibition abilities (Garon et al., 2008; Hendry et al., 2016). Further, some researchers included short-term memory tasks in their EF batteries for younger children, such as forward span tasks, in which children are asked to remember stimuli in the same order as presented (Mulder et al., 2014; Wiebe et al., 2011). The reason is that in young children, short-term memory tasks may tap into working memory because they have not yet proceduralized certain sequencing skills and rely on their working memory abilities for the rehearsal of the information during short-term memory tasks (Hutton & Towse, 2001). Due to these differences, EF in early childhood is referred to as *emerging EF* by some researchers (Finegood & Blair, 2017; McDermott & Fox, 2018).

Individual differences in EF development originate from both genetic and environmental influences (Miyake & Friedman, 2012; Tomlinson et al., 2022). Extensive research suggests that characteristics of social environments such as the quality of adult–child interactions contribute to the development of EF (Anderson et al., 2010; Cheng et al., 2018; Hughes & Ensor, 2009). Earlier work has largely focused on the impact of parent–child interactions on child EF (for reviews, see Deater-Deckard, 2014; Fay-Stammbach et al., 2014), but teacher–child interactions have been found to play an important role in child development as well, already from pre-kindergarten age onwards (Farran & Hofer, 2012). Many children start attending child-care centres and preschools well before they are 4 years old. Various studies have shown that the quality of interactions between teachers and infants or toddlers has significant effects on social and cognitive development, such as emotional self-regulation (Feldman & Klein, 2003), prosocial behaviours and school readiness (Burchinal & Cryer, 2003) and language outcomes (Girolametto & Weitzman, 2002).

Only recently, researchers started investigating the role of teacher behaviours in EF development of toddlers (Salminen et al., 2021). Since neural networks related to emerging EF abilities (e.g. anterior cingulate, dorsolateral prefrontal cortex, supplementary motor area and basal ganglia) are subject to substantial growth during toddlerhood (Garon et al., 2008; Rothbart & Posner, 2001; Zelazo et al., 2004; Zelazo & Müller, 2011), development during this period may be particularly susceptible to the quality of teacher–child interactions. For this reason, this study focuses on toddlerhood, to find out how teacher behaviours relate to EF development in early childhood.

Several theoretical frameworks are relevant for explaining the relationship between teacher–child interactions and child EF (for a review, see Koşkulu-Sancar et al., 2023). First, Attachment Theory (Bowlby, 1982) posits that teachers can act as attachment figures with whom children in early and middle childhood can emotionally connect (Commodari, 2013). When children receive consistent and sensitive responses for their needs (i.e. emotional support), they feel more secure about the availability and support of the teachers (Roorda et al., 2011; Verschueren & Koomen, 2012), and may experience less stress (Hatfield & Williford, 2017). This secure feeling and limited stress provide fruitful conditions for children to engage in challenging and stimulating activities that foster their self-regulated thoughts and actions, and gradually they integrate these skills in their repertoire of EF abilities (Calkins, 2004; Kochanska & Aksan, 1995; Lewis & Carpendale, 2009). Second, Sociocultural Theory (Vygotsky, 1978) provides explanations for the relation between teacher behaviours and child EF. Based on this theory, it has been argued that adults, including teachers, can provide assistance, so-called scaffolding, to encourage children to engage in higher-order activities that are at or just beyond their ability level (Winsler, 2009; Wood & Wood, 1996). Through teachers' scaffolding attempts, children find more opportunities to participate and actively engage in cognitively stimulating activities which, in turn, can improve their EF abilities (Pianta et al., 2002).

Following the theoretical framework for the relation between teacher–child interaction and child EF, particularly two aspects of teacher–child interactions that have been found and argued to be important for EF development of older children may be relevant for toddlers, but have not been investigated in this younger group of children: (1) emotional and behavioural support, and (2) instructional support (Fuhs et al., 2013; Hamre et al., 2013; Hamre & Pianta, 2007; Hatfield et al., 2016; Leyva et al., 2015). First, emotional and behavioural support is defined as the extent to which teachers establish a positive climate in the classroom, are sensitive to students' needs, encourage activities that help self-regulatory behaviours of children, set up clear rules and redirect children's misbehaviours as well as promote productivity by managing instruction and transition time. Empirical research shows positive effects of teachers' emotional and behavioural support on children's EF development in preschool- and elementary school-aged children. Fuhs et al. (2013) observed, for example, that teachers' level of approving behaviours towards students and positive emotional tone positively predicted growth in EF scores of 4-year-old children over a period of approximately 6 months. Berry (2012) found that higher conflict levels (i.e. emotionally negative and conflictual relationships) between teachers and children across elementary school predicted lower inhibitory control abilities in children. Through teachers' behavioural support, children receive external help to organize their own behaviours and they can internalize these regulation strategies for cognitive and behavioural control (Berry, 2012; Cadima et al., 2016; Vandenbroucke et al., 2018). Several studies showed that better classroom organization positively predicted working memory and inhibitory control performance of preschool children (Hamre et al., 2014; Hatfield et al., 2016). In well-organized classrooms, students spend less time in transition activities and can focus more on learning and cognitively stimulating activities, which in turn could provide a basis for EF improvement (Cameron et al., 2005; Choi et al., 2016). Second, instructional support is the degree to which teachers facilitate learning and developmental activities such as math and literacy, provide qualitative feedback and model language to help children comprehend and use language. Previous research showed that the degree of teachers' instructional support is positively related to cognitive flexibility (Leyva et al., 2015) and inhibitory control performance (Hatfield et al., 2016) in 4-year-old children.

Many studies found effects of the quality of teacher–child relationships on EF development in children starting from the age of 4 (for a review, see Vandenbroucke et al., 2018). To the best of our knowledge, the relation between teacher–child interactions and EF development has been examined in toddlerhood in only one study

(Salminen et al., 2021). Salminen et al. (2021) compared the relationship between teacher behaviours and toddlers' EF (selective attention, inhibition control and working memory) in Portuguese and Finnish classrooms. They found that, in Finland, instructional support of teachers was positively related to selective attention and inhibitory control, while emotional and behavioural support of teachers was only related to inhibitory control. In Portugal, on the other hand, only instructional support was positively associated with toddlers' selective attention. These findings indicate that the link between teacher behaviours and toddlers' EF development might vary across different cultural contexts. The authors argued that distinct findings could stem from a stronger emphasis on the curriculum in early childhood education and care settings in Finland, compared to toddler classrooms in Portugal. Further, the levels of emotional and behavioural support in Portugal might not have reached a minimum level to make substantial contributions to EF development of toddlers. Therefore, there is not only a need to investigate the link between teacher–child interactions and EF development in toddlerhood but also in other cultural contexts.

1.2 | Current study

The aim of the current study is to investigate whether the quality of teacher–child interactions when children are 2 years old predicts EF development from age 2 to age 3 which was assessed through selective attention, verbal short-term memory and visuospatial working memory tasks at two time points. The study was conducted in the Netherlands. Based on previous work on older children (Hamre et al., 2014; Hatfield et al., 2016; Leyva et al., 2015), we expect that higher quality of teachers' supportive behaviours when children are 2 years old are positively related to toddlers' EF development. Given the previous mixed findings, we do not have specific expectations about which teacher behaviours will be more strongly related to development in EF abilities.

2 | METHOD

2.1 | Procedures

Data of the current study were collected within the Pre-COOL study (Pre-COOL Consortium, 2012; pre-cool.nl) project which ran between 2010 and 2014. The Pre-COOL study investigated the process and structural quality of preschools and kindergartens in relation to children's socio-cognitive and linguistic development in the Netherlands. The study included both home-based data (collected from parents and children at home) and institution-based data (collected from teachers and children at schools). For the current study, we focused on the institution-based data. The Pre-COOL is linked to the national cohort study COOL. The COOL was an ongoing developmental study which aimed to follow the educational career of students from age 5 to 18 years. Children participating in The Pre-COOL were further studied in the context of COOL. To increase the likelihood of preschool children entering primary schools that take part in study COOL, the sample was recruited when children were attending preschools or care centres in the following way. First, a sample of 300 primary schools that was randomly drawn from the COOL cohort was approached and 139 agreed to participate. Participating schools were asked to identify the preschools and daycare centres that were attended by most of their new students. In addition, municipal records and the Internet were used to recruit additional preschools and daycare centres in the neighbourhoods of the primary schools. Over 500 centres that were approached, 263 agreed to participate in the Pre-COOL. For methodological and logistic reasons, classroom observations were conducted in classrooms with at least four children participating in the child assessments of the Pre-COOL study, resulting in 162 centres and 276 classrooms.

Teachers were asked to personally inform parents about the study and parents were given an information letter in which they were given the opportunity to withdraw their child from participation. Approval for the study was obtained from both Ethical Advisory Committees of the Faculty of Social and Behavioural Sciences of Utrecht

University and the Department of Education of the University of Amsterdam. Passive parental consent was allowed by the Ethical Advisory Committee of the Department of Education of the University of Amsterdam (the institution responsible for data collection), because of the major challenges involved with obtaining permission from all parents, and because all the assessments were child-friendly and noninvasive. Passive consent was in line with the ethical procedures at the University of Amsterdam by the time when this study was conducted, and the study procedures were in line with the Netherlands Code of Conduct for Research Integrity (2018).

For the current study, we used data of participants from the first and second waves (time points) of this longitudinal project, when children were 2 and 3 years old, respectively. At the first wave, when children were 2 years of age, teacher–child interactions were observed in the classroom. At both waves, when children were 2 and 3 years of age, EF and vocabulary tasks were administered by research assistants in a quiet room at the daycare- or preschool centre. The tasks were administered in a fixed order in addition to other tasks that are not reported in this study. The order of the tasks was: receptive vocabulary, selective attention, verbal short-term memory and visuospatial working memory. Assessments at both waves lasted approximately 45 min. To guarantee a standardized procedure, the assessors underwent an intensive training before the data collection, which included attending a full-day training session, video recording administration of the tasks with a child of the relevant age submitted for review to the study team. Parents and teachers were asked to fill out a questionnaire with items addressing demographic variables.

2.2 | Participants

In the current study, we selected data for participants from the first and the second wave when children were 2 and 3 years old, respectively. There were 276 preschools and daycare centres from different parts of the Netherlands in the first and/or second wave of the Pre-COOL. From the original sample, classrooms ($n = 61$) were excluded if all of the children within those classrooms did not have data on any of the EF measures at both assessment waves. Further, respective EF scores of children outside the age range (i.e. younger than 24 months or older than 36 months at the first wave, and younger than 36 months or older than 48 months at the second wave; $n = 78$) were excluded from the analyses. The final sample consisted of 876 children and 215 teachers (all female). The average number of children in the classrooms was 14.61 at the first wave and 14.41 at the second wave, but not all children in the classrooms were enrolled in the study. Information about sample characteristics is presented in Table 1.

In an earlier publication about this sample (Leseman et al., 2017), an Item Response Theory approach across four measurement waves (2 to nearly 6 years) was taken to test how classroom quality predicted growth in selective attention. In this previous report, EF as a broader construct was not considered, that is, growth in verbal short-term memory and visuospatial working memory were not studied in relation to classroom quality. Moreover, measurement invariance of a latent EF construct over time was not investigated. We turn to the issue of measurement invariance in the data screening section.

2.3 | Materials

2.3.1 | Observed teacher behaviours

The CLASS-Toddler version (La Paro et al., 2014), which was validated in the Netherlands (Slot et al., 2017), was used to score live observations of teacher–child interactions. A Dutch translation was developed for the Pre-COOL study (Slot et al., 2015). As recommended by the developers of the CLASS, all observers were trained by a licensed CLASS trainer and had achieved at least 80% agreement within one scale-point with the trainer on an online test before

TABLE 1 Sample characteristics.

	N	Missing (*n*)	%	*M*	SD	Range
Child age (in months)						
First wave	757	119		28.60	2.83	24–35
Second wave	800	76		42.38	2.47	36–47
Gender		2				
Female	424		48.4			
Male	450		51.4			
Ethnicity		158				
Dutch	538		61.4			
Western and non-Dutch	33		3.8			
Non-Western and non-Dutch	147		16.8			
Home language		216				
Monolingual	490		55.9			
Bilingual	170		19.4			
Parental education						
Mother		180		3.18	0.84	1–4
1 (Primary school)	45		5.1			
2 (Lower vocational training)	64		7.3			
3 (Secondary school or vocational training)	309		35.3			
4 (Higher education)	278		31.7			
Father		222		3.11	0.86	1–4
1 (Primary school)	43		4.9			
2 (Lower vocational training)	81		9.2			
3 (Secondary school or vocational training)	288		32.9			
4 (Higher education)	242		27.6			
Institution type		2				
Daycare centre	390		44.5			
Preschool	484		55.3			
Teachers' experience (1–7)*	139	76		4.42	1.01	1–7

Note: *Teachers reported the number of years they had worked in preschools or daycare centres on a 7-point scale: (1) less than 1 year, (2) between 1 and 2 years, (3) between 3 and 4 years, (4) between 5 and 10 years, (5) between 11 and 12 years, (6) between 21 and 30 years and (7) more than 30 years.

they were admitted to the study (average agreement was 86.4%). Next, the observers joined live observations with the trainer once before data collection. Inter-rater agreement of the live observations within one scale-point was 89.9%. Research assistants observed each classroom in the morning in four 20-min cycles during regular activities such as pre-academic lessons, meal-snack times and creativity activities like drawing and painting. Teacher–child interactions were observed on eight dimensions using 7-point rating scales ranging from 1 or 2 (classroom is low on that item) to 3, 4 or 5 (classroom is average on that item) and to 6 or 7 (classroom is high on that item).

The Emotional and Behavioural Support factor combined five dimensions: *Positive Climate* refers to the overall degree of warmth and enjoyment in the classroom. *Teacher Sensitivity* captures teachers' ability to follow and respond to children's needs and interests. *Regard for Child Perspectives* taps the extent to which teachers encourage children's autonomy and place emphasis on children's interests during activities. *Negative Climate* encompasses the overall negativity in the classroom expressed by teachers or the children such as use of punitive control, sarcasm or disrespect (scores were reversed). *Behavioural Guidance* reflects the teachers' encouragement of positive behaviours, setting clear expectations in the classroom and redirecting negative behaviours of children.

The Instructional Support factor combined three dimensions: *Facilitation of Learning and Development* was rated based on how teachers support children's learning during pre-academic and stimulating activities. *Quality of Feedback* captures the degree of teachers' feedback and how well they promote children's participation in the classroom activities. *Language Modelling* encompasses the quality and quantity of teachers' language use and encouragement of children to speak in the classroom by asking open-ended questions.

2.3.2 | Executive function tasks

Selective attention

For the assessment of selective attention, children completed a visual search task (Mulder et al., 2014). The task consisted of three practice trials and three test trials. At the first wave, participants were shown 48 animals on a 6 × 8 grid with 40 distractors and eight targets on a laptop screen in all three trials. In the second wave, children were shown 48 animals (40 distractors and eight target objects) in the first two trials, and 68 animals (60 distractors and eight target objects) in the third trial. Children were instructed to find the targets (elephants) as quickly as possible among the distractors (bears and donkeys) which were similar to the targets in colour and size. In each test session, children were allowed to search for the targets for 40 s. The assessor encouraged and gave feedback to the child during the task. If the child pointed to a target, the assessor said: 'Well done! Can you find another elephant?' If the child pointed to a distractor, the assessor said: 'No, where is an elephant? Try to find the elephants quickly!' In order to reduce the memory load, the elephants located by children were crossed off with a blue line by the assessor by hitting a key. As the difficulty level of the third trial (i.e. eight targets with 60 distractors) at the second wave was higher than at the first wave, we only included the scores from the first two trials (i.e. eight targets with 40 distractors) at each wave to be able to compute growth in selective attention ability from the first to the second wave. In the selective attention task, trial scores of children who did not look at the screen at all during that trial for the full 40 s were set to missing, following the procedure used in earlier studies using this task (Mulder et al., 2014, 2017). Also, and again in line with earlier studies using this task (Mulder et al., 2014, 2017), task scores of children who did not have data on at least half the trials, and, who did not find at least one target across the valid trials were set to missing ($n = 60$ at the first wave; $n = 10$ at the second wave) to avoid calculating scores for children for whom it was likely that they did not fully understand the task. At each trial, children received a score based on the number of correct targets found out of eight. Therefore, each child had two scores corresponding to each trial of the task. Children's total score was calculated as the average of the two trials. Those scores were then converted into percentage scores (0–100). The task had satisfactory criterion, convergent and predictive validity (Mulder et al., 2014). The alpha coefficient was calculated based on the correlation between the scores from the two trials of the task. Internal consistency over the first two trials of the task in the current sample was, $\alpha = 0.83$ at the first wave and $\alpha = 63$ at the second wave.

Verbal short-term memory

To assess verbal short-term memory performance, children completed the *Nonword Repetition* task (Verhagen et al., 2019). In this task, children were presented with a video of a novel object appearing from a box and, at the same time, they heard a pre-recorded child-directed voice labelling the object with a non-existing word. The voice encouraged children to repeat the name of the object: 'Look a [jaat]! Say [jaat]'. The task consisted of two practice and 12 test trials. In half of the trials, monosyllabic words were used while in the other half bisyllabic words were used. If a child did not repeat the word, the assessor used the prompt sentence 'What is that?' without saying the name of the object. If a child still did not repeat the word, the video was played at most two more times. The assessors scored children's repetition attempts as 'correct' (when the child repeated all sounds of the item correctly in the correct order), 'incorrect' (when at least one sound was wrong or omitted) or 'unclear' (when the answer was not clear and the assessor could not decide if the answer was correct or incorrect). Six items were the same and the other six items were different in the first and second waves. To be able to compute the growth from the first to the second wave, we included only the same-item scores in the analyses. Some children responded to only a few items in the task. In order to avoid calculating sum scores on the basis of few responses, task scores of children who did not respond (with a correct or incorrect answer) in at least half of the trials were excluded from the analyses ($n = 143$ at the first wave; $n = 15$ at the second wave). Task scores were computed as the percentage of correct responses out of all responses (range 0–100). Internal consistency of the task in our sample was $\alpha = 0.74$ at the first wave and $\alpha = 0.60$ at the second wave.

Visuospatial working memory

Children's visuospatial working memory was assessed with an adapted version of the *Six Boxes Task* (Diamond et al., 1997; Mulder et al., 2014). First, children were shown six wooden toys hidden inside six identical boxes with lids. Then, they were told to search for one object and remove one object each time. In between the searches, the instructor distracted children for 6 s. During the distraction, the assessor raised one hand in the air and counted out loud on their fingers, while the child was looking at their hand. At the second wave, to facilitate distraction, the assessors additionally placed a screen between the child and boxes. During the task, children were asked to find toys in the boxes, which required them to remember the place of the objects and update their memory by remembering which objects had already been removed and which objects were still in the boxes. After a practice phase, children started searching for six objects. The percentage of correct responses (finding a toy) for children who had searched on all six trials was calculated (range 0–100). The task had satisfactory criterion, convergent and predictive validity (Mulder et al., 2014). Because children had to keep an increasing number of empty boxes in mind as they progressed through the task and each next attempt was more difficult than the previous successful attempt, children's responses on the task items were interdependent. Due to the interdependence of the test items, it was not possible to investigate the internal consistency of the Visuospatial working memory task.

2.3.3 | Control variables

To account for the effects of child language, background characteristics and institution types, we used the following control variables.

Receptive vocabulary

A shortened version of the Dutch *Peabody Picture Vocabulary Test* (PPVT-III-NL; Dunn & Dunn, 2005; Verhagen et al., 2019) was used at the first wave. In each item, children were presented with four pictures on a laptop screen and asked to choose the picture that corresponds to the word they heard. In total, children were presented with 24 items. Vocabulary scores of children who did not respond to at least half of the items were excluded from the analyses ($n = 123$). Scores were computed as the percentage of correct responses out of the total responses (range 0–100). The internal consistency of the task was $\alpha = 0.88$.

Ethnicity

Parents reported their children's ethnicity, which was scored into three categories: 0 = Dutch, 1 = Western and non-Dutch and 2 = non-Western and non-Dutch.

Multilingualism

Parents reported whether their child was exposed to Dutch only or to another language instead of or alongside Dutch at home. If this information was missing from the questionnaire, research assistants asked parents or teachers at preschools or daycare centres. If children were exposed to Dutch only, they were assigned a score of 0 = monolingual on this variable. If children heard another language than Dutch or both Dutch and another language at home, they were assigned a score of 1 = multilingual.

Parental education

Parental education level was reported by parents on a 4-point scale: (1) primary school, (2) lower vocational training, (3) secondary school or vocational training and (4) higher education. The average of both parents' education level was used in the analyses ($M = 3.09$, SD = 0.80). If parental education information was missing, it was acquired through the school registration system where possible.

Institution type

Children in the Netherlands can attend two types of institutions before the age of 4 years: daycare centres and preschools. Daycare centres offer full day care 5 days a week, but most children attend day care only a few days a week. Also, even though income-dependent government subsidies are provided, fees are relatively high in daycare centres. Therefore, it is mostly attended by children from families with higher socioeconomic status backgrounds. Preschools, on the other hand, provide a half-day programme ranging from 2 to 4 days a week. The fees are income-dependent, so it is mostly attended by children from disadvantaged and minority families (Leseman et al., 2017). The variable institution type represents whether children attended 0 = daycare centres or 1 = preschools.

3 | DATA SCREENING AND PREPARATORY ANALYSES

Before the main analyses, the multilevel structure of EF outcome variables was examined, and the factor structure was examined for both outcome (EF) and predictor (teacher behaviours) variables.

3.1 | Multilevel structure of EF tasks

Intraclass correlation (ICC) scores for the change scores in selective attention (0.11), verbal short-term memory (0.34) and visuospatial working memory (0.08) were checked to determine whether the nested structure of the data (students nested in the classrooms) should be taken into account. Based on the high ICC for the verbal short-term memory task, we used a multilevel approach. In addition, we tested whether the random slopes had significant variance on the between (classroom) level for each predictor and outcome variable. As none of the random slopes had significant variance (which indicates that outcome variables did not vary significantly across classrooms), we did not include random slopes in further analyses.

3.2 | Factor structure of CLASS-Toddler

Although a two-factor model of the CLASS-Toddler version is most commonly used (Emotional and Behavioural Support vs. Instructional Support; Castle et al., 2016; Choi et al., 2019), other research used a three-factor model (Emotional Support, Behavioural Support and Instructional Support; Slot et al., 2017). Therefore, we first checked the factor structure of the data obtained with the CLASS-Toddler in our sample. Model fit indices of a multilevel confirmatory factor analysis (CFA) showed that the three-factor model (Comparative Fit index (CFI) = 0.98, Tucker Lewis Index (TLI) = 0.96, Root Mean Square Error of Approximation (RMSEA) = 0.04, Root Mean Square Residual $(\text{SRMR})_{\text{within}} = 0.00$, $\text{SRMR}_{\text{between}} = 0.04$, AIC = 3090.03, BIC = 3218.96) fitted the data better only slightly than the two-factor model (CFI = 0.97, TLI = 0.95, RMSEA = 0.04, $\text{SRMR}_{\text{within}} = 0.00$, $\text{SRMR}_{\text{between}} = 0.04$, AIC = 3094.26, BIC = 3213.65). Considering the fact that the CLASS-Toddler developers (La Paro et al., 2014) suggest a two-factor structure and studies in the field have mostly used the two-factor model in their analyses, we decided to proceed with the two-factor model. In the two-factor model, all dimensions significantly loaded on their respective factors and loadings ranged between 0.60 and 0.89 (all *p*'s < 0.001). As our data had a multilevel structure, we tested whether the two-factor CLASS model fitted the data well at the within (student level) and between levels (classroom level). We calculated the model fit indices for both levels and for the maximum likelihood estimates with standard errors that are robust against violations of normality and independence of the observations (Brosseau-Liard et al., 2012; Brosseau-Liard & Savalei, 2014; Ryu & West, 2009). The data showed a good fit at within, CFI = 0.99, TLI = 0.89, RMSEA = 0.04, SRMR = 0.00, and between levels, CFI = 0.97, TLI = 0.91, RMSEA = 0.09, SRMR = 0.04.

3.3 | Factor structure of EF tasks

We know from previous work on the XXX study that a single latent EF factor fitted the data well at wave 1 (Slot et al. 2015), but this has not been studied in wave 2. CFA revealed a reasonably good fit for a single latent factor at each wave, CFI = 0.92, TLI = 0.85, RMSEA = 0.06, SRMR = 0.04. Factor loadings for each task were significant and ranged between 0.33 and 0.65 (all *p*'s < 0.001). We then performed longitudinal measurement invariance analyses with the three EF tasks to check whether the EF factor structure was similar across the two waves (Muthén & Muthén, 1998-2017). Specifically, we ran a series of CFAs in which constraints to different parameters were consecutively added. In the first model, a baseline model was built in which all parameters were freely estimated across the two waves. In the second model, the factor loadings of the EF tasks were constrained to be equal to their equivalent tasks across two waves. In the third model, intercepts of the EF tasks were constrained to be equal to their equivalent tasks across two waves. The change in model fit between the first and second, and second and third models was tested by using Satorra–Bentler's scaled chi-square difference tests. When all task scores were constrained, invariance for the factor loadings and indicator intercepts was achieved. However, when individual factor loadings of the tasks were released, invariance of the verbal short-term memory task was not supported. When indicator intercepts of individual tasks were freed, invariance was not achieved for the verbal short-term memory and visuospatial working memory tasks. Summary of fit statistics for measurement invariance of EF latent factors at the first and the second wave for each step can be seen in Appendix A. As the invariance of EF latent factors was not supported, we decided to use individual task scores.

4 | ANALYTIC APPROACH

Multilevel Structural Equation Modelling (SEM) was used to examine the predictive role of teacher behaviours in the EF development of children. Regarding the dependent variables, EF, we chose a change score strategy over residualized change scores (which are calculated by regressing the pre-test scores on the post-test scores while taking the difference). We came to this decision since we found significant correlations between EF scores at 2 years and CLASS scores at 2 years (see Table 3). Several analytical and empirical studies showed that change scores yield more reliable results when there are significant correlations between pre-test scores and the predictors, and when the pre-test scores are not homogeneous across participants (Castro-Schilo & Grimm, 2018; Van Breukelen, 2006).

We built separate models for each of the three outcome variables (change scores in selective attention, verbal short-term memory and visuospatial working memory) due to complexity and non-convergence of the models when the three outcome variables were included in a single model. We also entered the predictor variables in separate models due to a rather high correlation between Emotional and Behavioural Support and Instructional Support ($r = 0.66$). Both CLASS latent factors were included in each model, but the regression path was added only for one of the predictor variables (Emotional and Behavioural Support or Instructional Support). EF change scores were included as outcome variables, which we calculated as the difference between individual EF scores at 3 years and individual EF scores at 2 years. Vocabulary, ethnicity, multilingualism, parental education and institution type were added as control variables on both predictors and outcome variables, and age of children at the first wave was added as a control variable only on the outcome variable in the models. After starting with a full model, we followed a model pruning approach by removing the non-significant relations with control variables from the model starting from the least significant relation (based on *p* values) until reaching a good-fitting model (Landis et al., 2000; Molzon et al., 2018; Streiner, 2006).

All models were performed in Mplus version 8.8 (Muthén & Muthén, 1998–2017) and estimated with maximum likelihood with robust standard errors (MLR) (Little et al., 2014). Full information maximum likelihood was used to handle missing data. This approach allows all information available to be incorporated in the analyses, thus enabling it to handle any missing data on the indicators of the latent constructs (Baraldi & Enders, 2010). Model fit was evaluated based on the following criteria: CFI and TLI >0.90, and RMSEA and SRMR <0.08 (Hu & Bentler, 1999; Kline, 1999).

5 | RESULTS

5.1 | Descriptives and correlations

Descriptive statistics for CLASS factors and EF task scores are presented in Table 2. On average, teachers' scores for Emotional and Behavioural Support were higher than their mean scores on Instructional Support. The mean scores on EF tasks showed that there was growth in all EF measures from the first to the second wave. The correlations among the main study variables are provided in Table 3.

5.2 | Multilevel structural equation modelling

Below, we present the results for the respective models including change scores in selective attention, verbal short-term memory and visuospatial working memory. See Appendix B, for a sample depiction of the full models for selective attention with emotional and behavioural support, and instructional support as predictors.

5.2.1 | Selective attention

The full multilevel SEM model with Emotional and Behavioural Support as the predictor and selective attention change scores as the outcome variable did not show good model fit. By pruning control variables from the model, an acceptable model fit was reached, CFI = 0.92, TLI = 0.89, RMSEA = 0.04, $SRMR_{within}$ = 0.08, $SRMR_{between}$ = 0.11 (see Figure 1). This model showed that there was no significant association between Emotional and Behavioural Support and selective attention change scores. The pruned model with Instructional Support as the predictor revealed an acceptable model fit, CFI = 0.92, TLI = 0.89, RMSEA = 0.04, $SRMR_{within}$ = 0.08, $SRMR_{between}$ = 0.12 (see Figure 2). Results indicated that Instructional Support of the teachers positively predicted the change in children's selective attention scores. That is, when teachers demonstrated higher levels of instructional support, children in their classrooms displayed more improvements in selective attention scores from the first to the second wave.

In both models, age and vocabulary at wave 1 were significantly and negatively related to change in selective attention scores, indicating that having a younger age and lower vocabulary at the first wave was related to larger increases in selective attention scores from the first to the second wave. In addition, institution type was positively

TABLE 2 Descriptive statistics for teacher behaviours and Executive Function (EF) task scores.

	N	*M*	SD	Range
Teacher behaviours				
Emotional and behavioural support	215	5.33	0.58	3.55–6.65
Positive climate	215	5.37	0.99	2–7
Teacher sensitivity	215	5.30	0.82	3–7
Regard for child perspective	215	4.16	0.84	2.25–6.5
Negative climate	215	6.82	0.28	5.5–7
Behavioural guidance	215	4.5	0.79	2.25–7
Instructional support	215	3.27	0.81	1.58–5.83
Facilitation of learning and development	215	3.69	0.88	2–6.25
Quality of feedback	215	2.91	0.84	1–5.5
Language modelling	215	3.21	0.98	1.25–6.25
Child EF tasks				
2 years (% correct)				
Selective attention	678	46.92	21.30	6.25–100
Verbal short-term memory	552	33.60	31.17	0.00–100
Visuospatial working memory	678	65.54	18.95	0.00–100
3 years (% correct)				
Selective attention	791	78.57	13.67	12.50–100
Verbal short-term memory	778	53.67	27.85	0.00–100
Visuospatial working memory	741	81.83	15.76	20–100
EF change scores				
Selective attention	614	32.27	20.67	−18.75-93.75
Verbal short-term memory	494	23.70	36.26	−83.33-100
Visuospatial working memory	589	16.57	21.97	−60-100

linked to Instructional Support indicating that teachers in preschools displayed higher levels of instructional support compared to teachers in daycare centres.

5.2.2 | Verbal short-term memory

The full models for verbal short-term memory change scores of children with both predictors did not show good fit. Model pruning resulted in an acceptable model fit, CFI = 0.92, TLI = 0.90, RMSEA = 0.04, $SRMR_{within} = 0.07$, $SRMR_{between} = 0.06$ (see Appendix C). Results indicated that there was no main effect of Emotional and Behavioural Support of teachers on the change scores in verbal short-term memory from the first to the second wave. The pruned model with Instructional Support as the predictor showed acceptable fit, CFI = 0.92, TLI = 0.90, RMSEA = 0.04, $SRMR_{within} = 0.07$, $SRMR_{between} = 0.07$ (see Appendix C). Similarly, teachers' Instructional Support did not significantly predict the change in children's verbal short-term memory scores.

In both models, institution type was negatively linked to verbal short-term memory change scores (this was a marginal effect in the model with Emotional and Behavioural Support as the predictor, $p = 0.06$) and positively linked to Instructional Support. This finding indicates that children in preschools showed less improvement in verbal short-term memory scores from the first to the second wave than children in daycare centres, while teachers in preschools

TABLE 3 Correlations among study variables.

	1	2	3	4	5	6	7	8	9	10	11
Teacher behaviours											
1. Emotional and behavioural support	–										
2. Instructional support	0.66**	–									
EF tasks—2 years											
3. Selective attention	−0.03	−0.13**	–								
4. Verbal short-term memory	0.11*	−0.02	0.18**	–							
5. Visuospatial working memory	0.02	0.00	0.28**	0.22**	–						
EF tasks—3 years											
6. Selective attention	0.00	−0.03	0.34**	0.04	0.19**	–					
7. Verbal short-term memory	0.02	−0.03	0.21**	0.23**	0.09*	0.15**	–				
8. Visuospatial working memory	−0.02	−0.05	0.24**	0.17**	0.20**	0.21**	0.14**	–			
EF change scores											
9. Selective attention	0.01	0.12**	−0.81**	−0.14**	−0.16**	0.27**	−0.12**	−0.12**	–		
10. Verbal short-term memory	−0.10*	−0.02	0.00	−0.68**	−0.13**	0.06	0.56**	−0.05	0.03	–	
11. Visuospatial working memory	−0.02	−0.02	−0.05	−0.05	−0.72**	0.01	0.02	0.53**	0.05	0.07	–

Note: Pearson's correlations are reported.
Abbreviation: EF, executive function.
$^*p < 0.05$; $^{**}p < 0.01$.

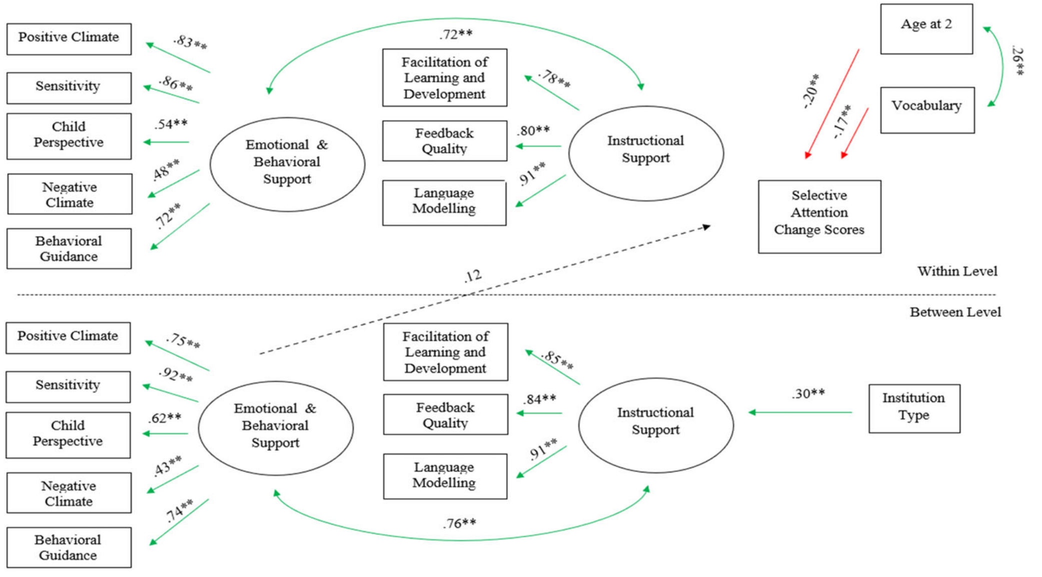

FIGURE 1 Emotional and behavioural support predicting children's selective attention change scores. Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. **p* < 0.05; ***p* < 0.01.

displayed higher levels of instructional support than teachers in daycare centres. Further, parental education was negatively related to Instructional Support, indicating that children of parents with lower levels of education received higher levels of instructional support from their teachers.

5.2.3 | Visuospatial working memory

The full models for visuospatial working memory change scores did not show good fit. After pruning, the model showed acceptable fit, CFI = 0.92, TLI = 0.90, RMSEA = 0.04, $SRMR_{within}$ = 0.08, $SRMR_{between}$ = 0.07, and revealed that Emotional and Behavioural Support was not related to visuospatial working memory change scores (see Appendix C). The pruned model with Instructional Support as the predictor showed acceptable model fit, CFI = 0.92, TLI = 0.90, RMSEA = 0.04, $SRMR_{within}$ = 0.08, $SRMR_{between}$ = 0.07. Similarly, teachers' Instructional Support did not significantly predict the change in children's visuospatial working memory scores (see Appendix C).

In both models, child age at the first wave was negatively related to change scores indicating that younger children in the first wave showed more improvement in visuospatial working memory abilities compared to older children. Further, Instructional Support was negatively linked to parental education, indicating that children with lower parental education received higher levels of instructional support from their teachers. Moreover, Instructional Support was positively linked to institution type, indicating that children attending preschools received higher levels of instructional support than children in daycare centres.

6 | DISCUSSION

The aim of the current study was to investigate the role of teacher–child interactions in toddlers' EF development from age 2 to 3 years. Specifically, we examined whether the quality of teachers' emotional and behavioural support

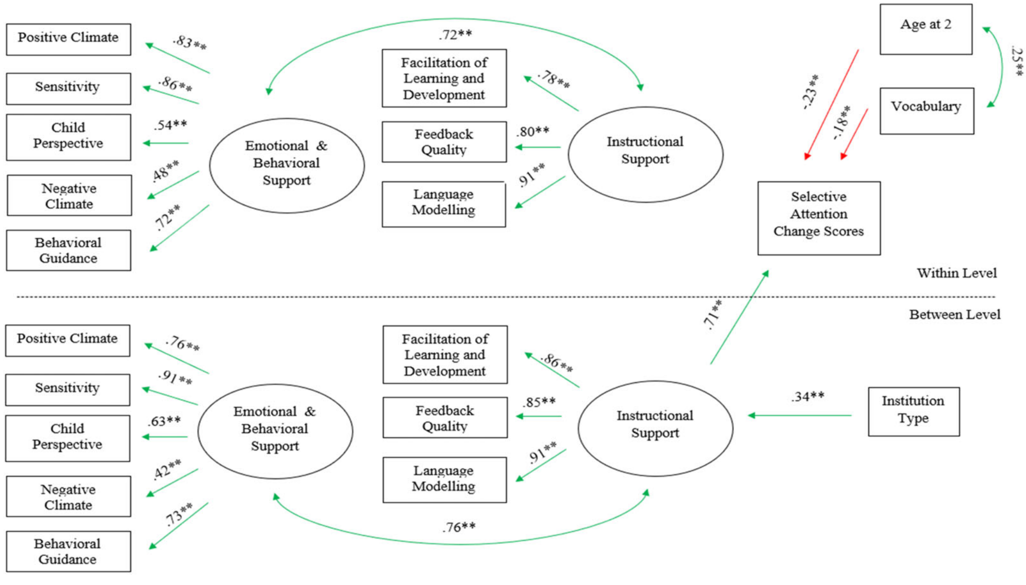

FIGURE 2 Instructional support predicting children's selective attention change scores. Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. *$p < 0.05$; **$p < 0.01$.

and instructional support assessed by classroom observations predicted toddlers' development in selective attention, verbal short-term memory and visuospatial working memory measured through an EF task battery. Our results indicated that teachers' instructional support positively predicted growth in selective attention but was not related to children's growth in verbal short-term memory and visuospatial working memory abilities. Moreover, emotional and behavioural support was not significantly related to changes in any of the EF measures. Findings regarding the specific EFs investigated in this study (selective attention, verbal short-term memory and visuospatial working memory) are discussed below.

6.1 | Relationship between teacher behaviours and toddlers' EF

With regard to instructional support of the teachers, the results of the current study revealed that, in general, when teachers displayed higher levels of instructional support, toddlers in their classrooms showed more growth in selective attention. This finding aligns with previous studies showing that teachers who provide higher levels of instructional support foster selective attention abilities in early childhood, including studies with toddlers and preschoolers (Leseman et al., 2017; Leyva et al., 2015; Salminen et al., 2021). Although interpretations about causal relations should be made with caution, this finding might be explained through several mechanisms. First, teachers characterized by higher levels of instructional support provide stimulating learning activities, which may encourage the selection of relevant information from teachers' instruction, and focusing attention on the task (McClelland et al., 2010; Pianta et al., 2002). Second, previous work on infants has shown that joint engagement with a parent can extend infants' duration of attentional focus during object play, a mechanism which has been referred to as 'the social origins of sustained attention' (Yu & Smith, 2016). The current study, together with the work by Leyva et al. (2015), Leseman et al. (2017) and Salminen et al. (2021) suggests that a similar mechanism may be at stake in interactions with teachers in toddlerhood, such that teachers who offer extended goal-directed activities that are guided by language reinforce selective attention development through joint engagement.

Contrary to our expectations, our results indicated that teachers' instructional support was not related to children's growth in verbal short-term memory and visuospatial working memory. One explanation could be related to the lack of assessment of more specific teacher behaviours such as memory-related activities in the current study. For the improvement of memory skills, preschool- and primary school-aged children can be taught memory strategies such as holding multiple heuristics in mind (Blair et al., 2005; Diamond et al., 2007; Dunning et al., 2013). Therefore, more memory-related specific instructions, such as encouraging children to engage in multi-step procedures or activities, may be needed to stimulate short-term and working memory capacities of toddlers as well. Future research can investigate the relation between teachers' scaffolding in memory-related activities and development in memory abilities of students in early childhood education and care centres.

In contrast to our expectations, we found that emotional and behavioural support of teachers did not predict the growth in any of the EF measures. In this respect, it is relevant to note that previous findings regarding the association between teachers' emotional support and children's EF development in older children (i.e. preschool aged children) is inconsistent while some studies showed positive relations (Fuhs et al., 2013), other studies found null (Leyva et al., 2015), or negative associations (Hamre et al., 2014). In our sample, teachers displayed medium-to-high levels of emotional and behavioural support ($M = 5.33$, SD $= 0.58$), while they showed medium levels of instructional support ($M = 3.27$, SD $= 0.81$) which is in line with previous findings in US and European samples (Burchinal et al., 2010; Mashburn et al., 2008; Pianta et al., 2008; Salminen et al., 2021; Slot et al., 2017). Most teachers in our sample probably showed 'good enough' emotional and behavioural support, and variation between teachers in this type of support (SD $= 0.58$) was less important for predicting EF growth. Teachers' quality of instructional support was lower and differed more between teachers. Taken together, these findings seem to suggest that when emotional and behavioural support is at a 'good enough' level, differences in instructional support quality can make a difference in toddlers' EF development. Moreover, with regard to visuospatial working memory, none of the teacher behaviours in our study were related to working memory development which aligns with the findings of Salminen et al. (2021). One possible explanation may have to do with measuring visuospatial working memory where a ceiling effect appeared especially at the second wave, with the majority (76%) of toddlers receiving a score of ≥80% correct.

6.2 | Relationship between teacher behaviours and toddler EF in different settings

Findings of the present study contribute to the literature by studying teacher behaviours and their relation to toddler EF in the Dutch context. When we compare our findings to the findings by Salminen et al. (2021), it appears that the level of emotional and behavioural support was the highest in teachers in Finland, then in Dutch teachers (medium/high) and lower but still at medium level in Portuguese teachers. Results regarding instructional support were similar in the three countries, as teachers showed medium-to-low levels of instructional support. Further, in the three countries, teachers' level of instructional support positively predicted selective attention performance of toddlers while emotional support was associated with inhibitory control of toddlers only in Finland. These findings may suggest that the level of instructional support, and relationships with child EF, shows less cultural variation than the level of emotional and behavioural support, and relations with child EF, at least within the context of Europe.

Moreover, in addition to the differences in teacher behaviours across different cultures and their relation to EF development, our study showed that institution types, which also vary across cultural settings, may also have differential effects on toddlers' EF development through the varying levels of teachers' supportive behaviours. Early childhood education and care centres in the Netherlands are organized into two different settings: daycare and preschools. The primary aim of the daycare centres is to provide care when parents are working, while preschools aim to stimulate development of children from more disadvantaged backgrounds (Leseman et al., 2017). Our analyses and previous analyses on the same dataset consistently showed that teachers in preschools displayed more instructional support in the classrooms compared to teachers in daycare centres, which seems to be in line with the goals of preschool policy in the Netherlands (Leseman & Veen, 2016; Slot et al., 2017).

6.3 | Longitudinal measurement invariance

Unlike most studies in the field, we tested the presence of longitudinal measurement invariance of EF across the age of 2 and 3 years. Whether the structure of EF is similar across early childhood has received little attention in previous research. However, in longitudinal studies, testing measurement invariance of a latent EF factor is critical to check if similar constructs are measured over time. To our knowledge, only three studies performed longitudinal measurement invariance tests for the latent structure of EF in early childhood. All three studies demonstrated partial support for measurement invariance of EF over different time points (Blair et al., 2014, from 3 to 5 years; Hughes et al., 2009, from 4 to 6 years; Willoughby et al., 2012, from 3 to 4 to 5 years). To the best of our knowledge, ours is the first study investigating measurement invariance of a latent EF factor in the toddlerhood period. We found that the verbal short-term memory task showed varying factor loadings and intercept levels, and the working memory task showed different intercept levels across age 2 and 3 years. These findings confirm that the assessment of EF in young children requires specific attention, in particular in longitudinal designs. Moreover, various factors may play different roles in performance across different ages, such as motor or language skills, leading to measurement invariance. More research is needed with different sorts of tasks and approaches to disentangle whether measurement invariance is due to task properties in relation to developmental dynamics or due to the structure of EF during the toddlerhood period.

6.4 | Limitations

The present study has some limitations. In this study, we included only three EF tasks. Research suggests that various tasks tapping into the same and different components of EF should be included in task batteries to grasp the structure of EF better in young children (Garon et al., 2008). Further, especially at early ages, assessments may be more prone to measurement error due to external and internal (e.g. fatigue) factors. Moreover, internal consistency of the selective attention and verbal short-term memory tasks was rather low, especially at age 3. The possible reason for the low consistency could be the removal of the trials that were different across two waves, which were also the difficult trials at the second wave. It could be that variation in the performance of children in these tasks may not be captured well enough with the inclusion of only the relatively simple trials at the second wave. Further, note that the selective attention task had only two trials and short-term memory task had six trials. It is known that low number of items can lead to low alpha levels (Tavakol & Dennick, 2011). As we did not want to calculate total scores in verbal short-term memory based on few responses, we excluded participants who did not respond to at least half of the trials. Other approaches to deal with the missing cases could be using Item Response Theory Approach or mixed effects modelling which analyses scores on the item level. However, we initially aimed to use latent factors for EF to have robust scores which are less affected by measurement issues than task scores. As the measurement invariance was not found in our dataset, we used task scores rather than the latent factor scores. Future research should consider using a more advanced technique for dealing with the missing cases on the item level.

6.5 | Future directions and implications

The current study also has implications for future research. Our study showed that in the Dutch early education system, teachers demonstrate high levels of emotional and behavioural support while the level of instructional support is medium to low. Findings suggest that variation in the levels of teachers' instructional support may be more crucial for the EF development of toddlers than emotional and behavioural support. Because of the complexity of our statistical models, we were unable to test the interaction effect between two teacher behaviours on toddlers' EF development. Future studies should examine whether the effect of a specific teacher behaviour depends on the levels of other behaviours. Future (experimental) studies can also examine the bidirectionality of relations, and whether toddlers' EF levels influence the way teachers behave, or vice versa, or both. Our findings from the Dutch context supplement those of Salminen et al. (2021), and suggest cultural differences in teacher behaviours and how these impact on child EF development. Because our study was not designed to investigate cultural differences, we refrain from speculating about underlying mechanisms, but we consider this an important avenue for future research. Finally, micro-trial studies (Mouton et al., 2018; Staff et al., 2021) may give the opportunity to investigate which specific teacher behaviours are important for EF development in early childhood. For example, more specific behavioural measures of constructs that are conceptually more closely related to EF, such as teachers' EF-related behaviours in the classrooms can be investigated in the context of child EF development (Bardack & Obradović, 2019).

Findings of the present study also inform educational programmes and policymakers. We showed that toddlerhood is an important period during which teacher behaviours affect EF growth. Further, as selective attention in early childhood is a foundation for complex EFs in later stages and is malleable through social interactions with mature adults (Fisher, 2019; Hendry et al., 2016), it is necessary to unravel which socialization processes can reinforce the development of this ability. Based on the findings of this study, interventions and prevention programmes can encourage teachers to promote selective attention abilities of toddlers by providing more learning activities, giving positive feedback to children's participation to those activities and stimulating language use in the classrooms. Educational programmes that aim to facilitate selective attention in early childhood should invest more resources in enhancing teacher–child interactions, with a particular focus on enhancing the quality of teachers' instruction.

AUTHOR CONTRIBUTIONS

Sümeyye Koşkulu-Sancar: Conceptualization; data curation; formal analysis; investigation; visualization; writing – original draft. **Elma Blom:** Conceptualization; supervision; writing – review and editing. **Eva van de Weijer-Bergsma:** Conceptualization; supervision; writing – review and editing. **Elizabeth Grandfield:** Formal analysis; writing – review and editing. **Josje Verhagen:** Conceptualization; writing – review and editing. **Hanna Mulder:** Conceptualization; investigation; project administration; supervision; writing – review and editing.

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PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1002/icd.2474.

DATA AVAILABILITY STATEMENT

Data of the pre-COOL study can be requested through Data Archiving and Network Services which is an institute of the Dutch Research Council (NWO).

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APPENDIX A

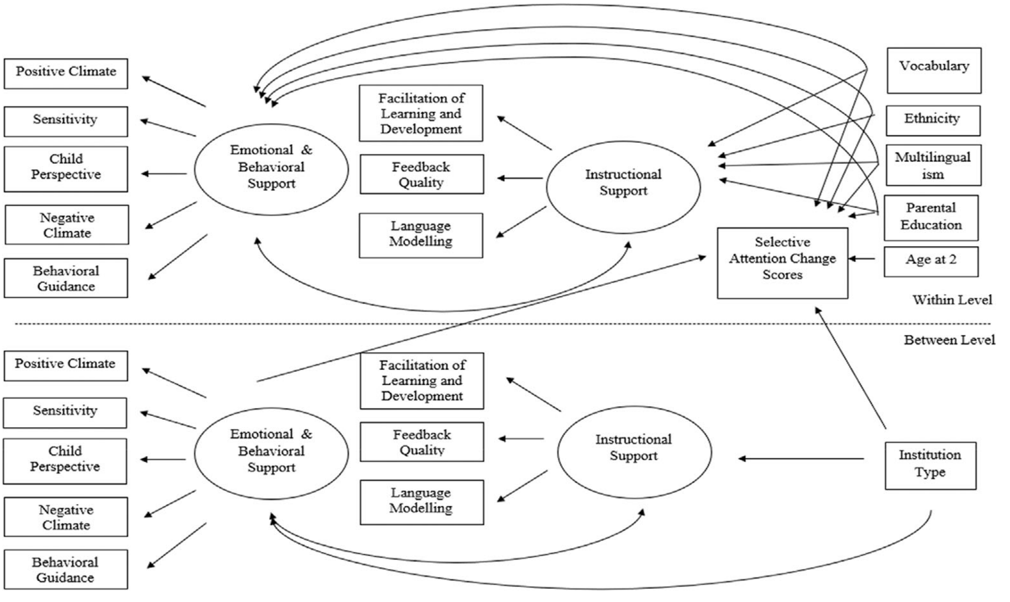
Summary of fit statistics for measurement invariance of executive function latent factors at first and second waves

	X^2	*df*	CFI	RMSEA	Comparison	$\Delta SB\text{-}X^{2(a)}$	*df*	*p*
1. Baseline model	13.792	5	0.97	0.04	–	–	–	–
2. Factor loadings constrained	19.900	7	0.96	0.05	1 vs. 2	5.99	2	0.05
2.1. Factor loadings constrained except for selective attention	13.207	6	0.98	0.04	1 vs. 2.1	0.10	1	0.74
2.2. Factor loadings constrained except for verbal short-term Memory	20.501	6	0.95	0.05	1 vs. 2.2	6.13	1	0.01
2.3. Factor loadings constrained, except for visuospatial working memory	15.685	6	0.97	0.04	1 vs. 2.3	2.16	1	0.14
3. Indicator intercepts constrained	23.004	9	0.95	0.04	2 vs. 3	3.26	2	0.20
3.1. Indicator intercepts constrained, except for selective attention	13.076	7	0.98	0.03	2.1 vs. 3.1	0.11	1	0.74
3.2. Indicator intercepts constrained, except for verbal short-term memory	26.859	7	0.93	0.06	2.2 vs. 3.2	5.56	1	0.02
3.3. Indicator intercepts constrained, except for visuospatial working memory	23.338	7	0.94	0.05	2.3 vs. 3.3	7.40	1	0.01

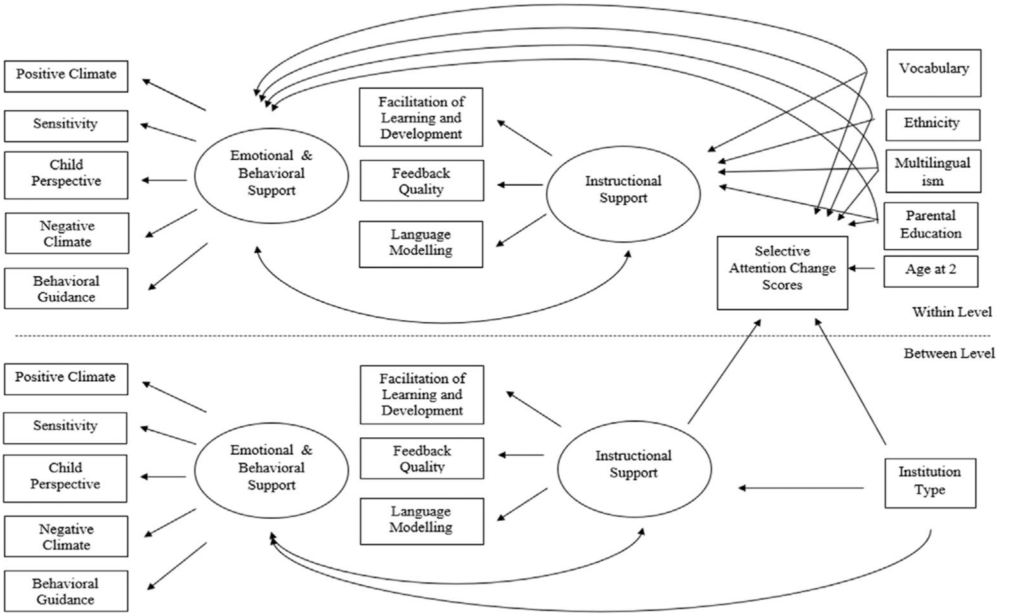
[a]Satorra–Bentler scaled chi-square test.

APPENDIX B

Full structural equation model—emotional and behavioural support predicting children's selective attention change scores.

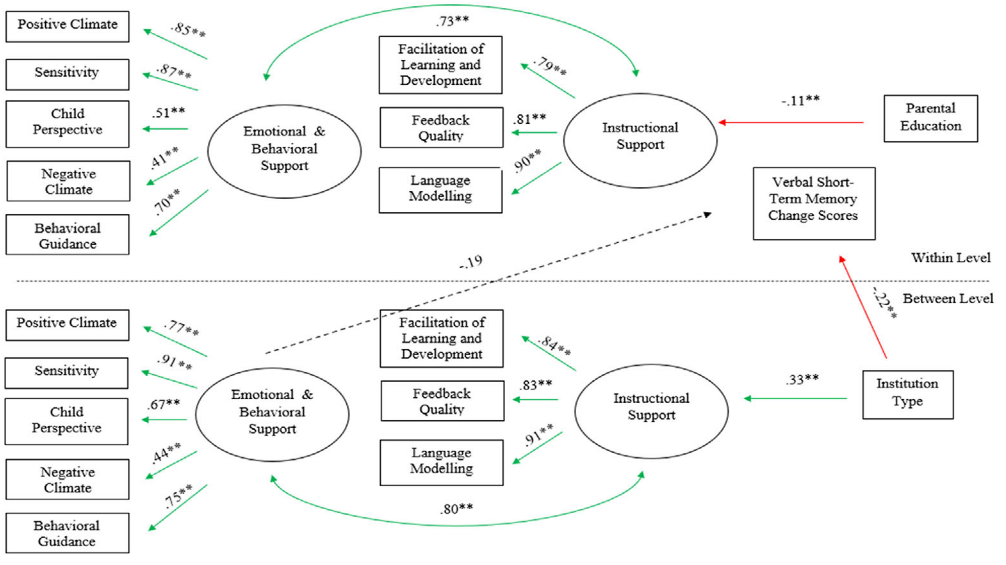


Full structural equation model—instructional support predicting children's selective attention change scores.



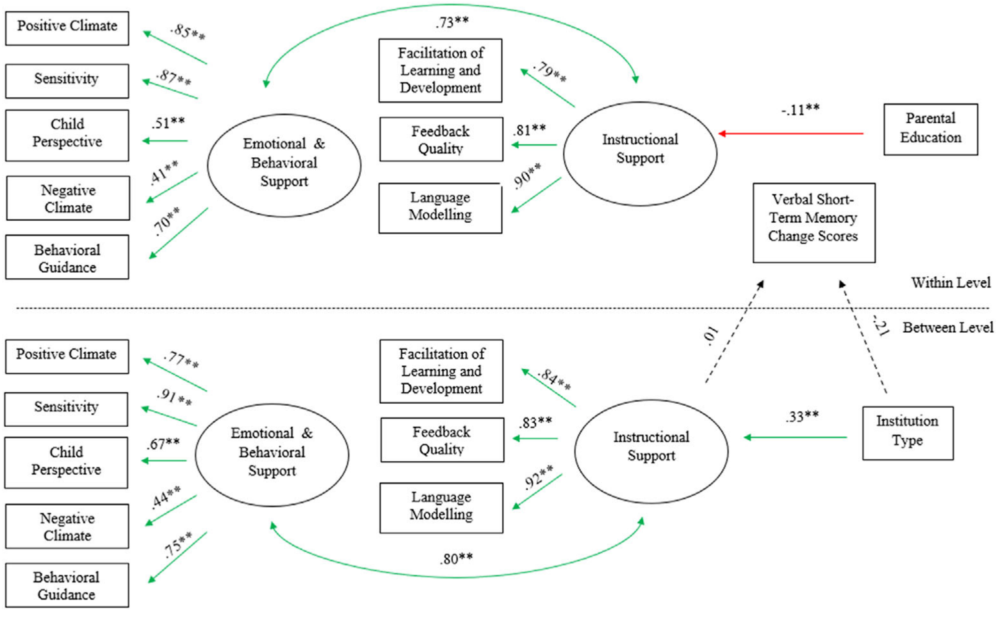
APPENDIX C

Emotional and behavioural support predicting children's verbal short-term memory change scores.



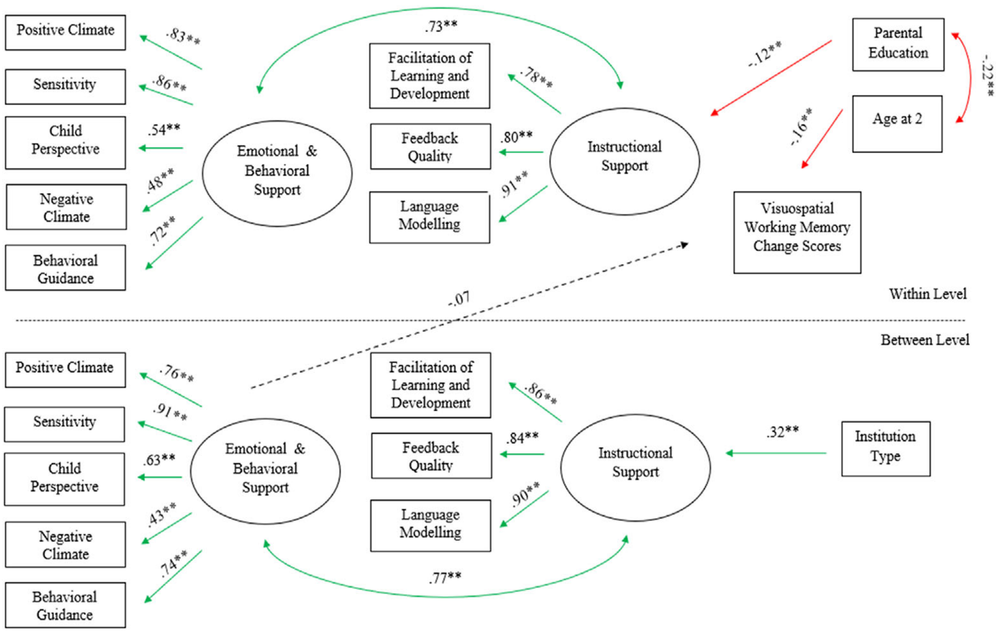
Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. *$p < 0.05$; **$p < 0.01$.

Instructional support predicting children's verbal short-term memory change scores.



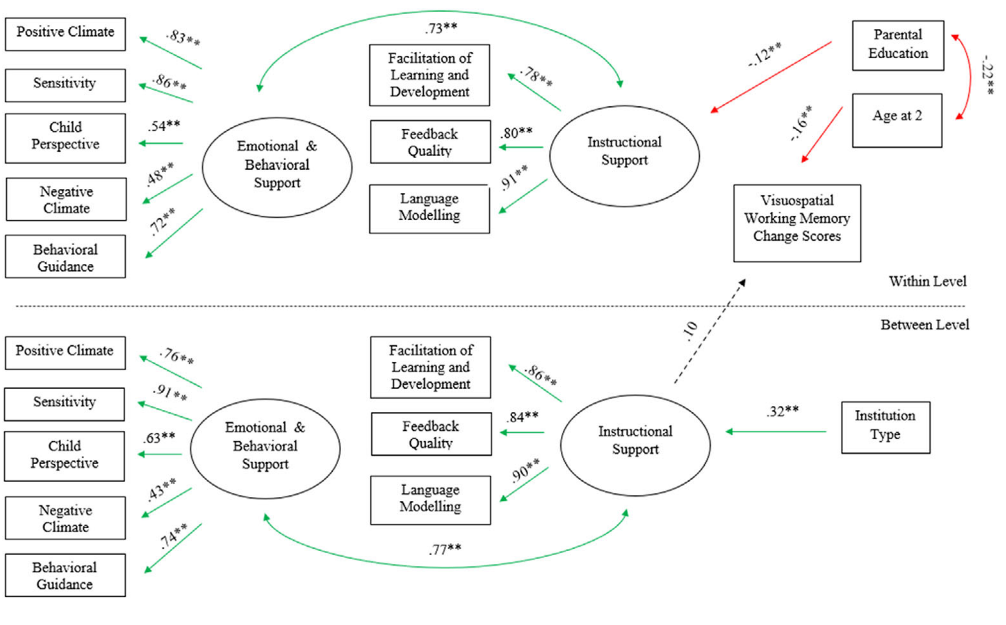
Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. *$p < 0.05$; **$p < 0.01$.

Emotional and behavioural support predicting children's visuospatial working memory change scores.



Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. *$p < 0.05$; **$p < 0.01$.

Instructional support predicting children's visuospatial working memory change scores.



Statistics are standardized regression coefficients. Green lines indicate positive relations, red lines indicate negative relations and dotted lines indicate non-significant relations. *$p < 0.05$; **$p < 0.01$.