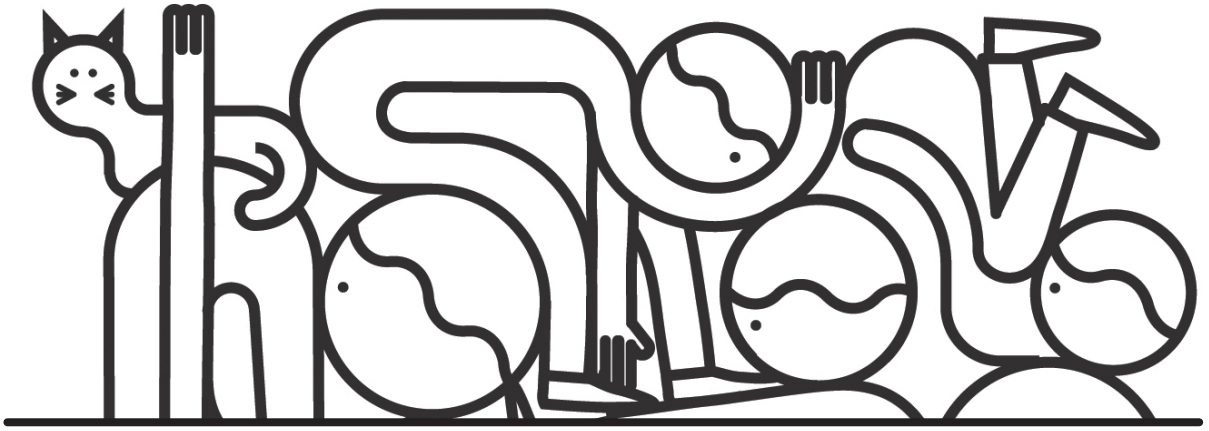
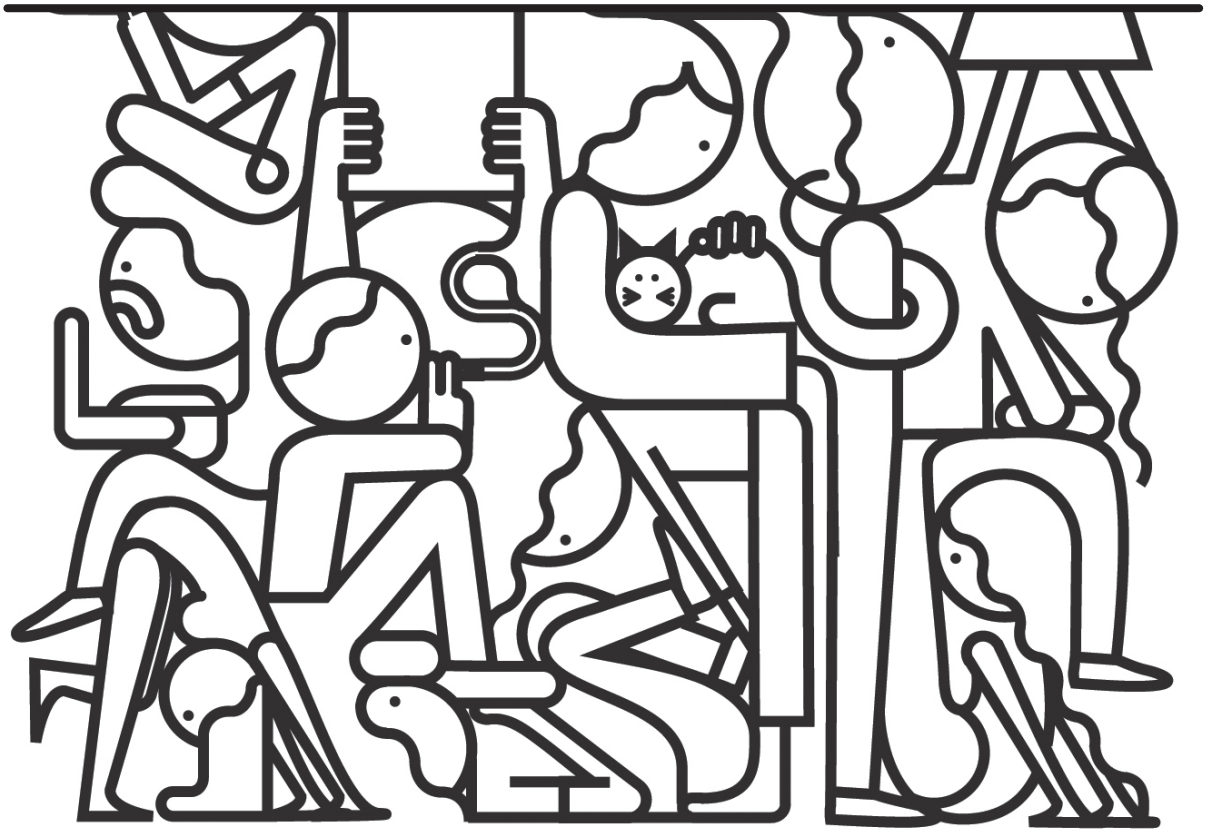


Enhancing preschoolers' vocabulary through family literacy programs

Rosa Catharina Teepe



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Rosa Catharina Teepe
geboren op 20 maart 1988
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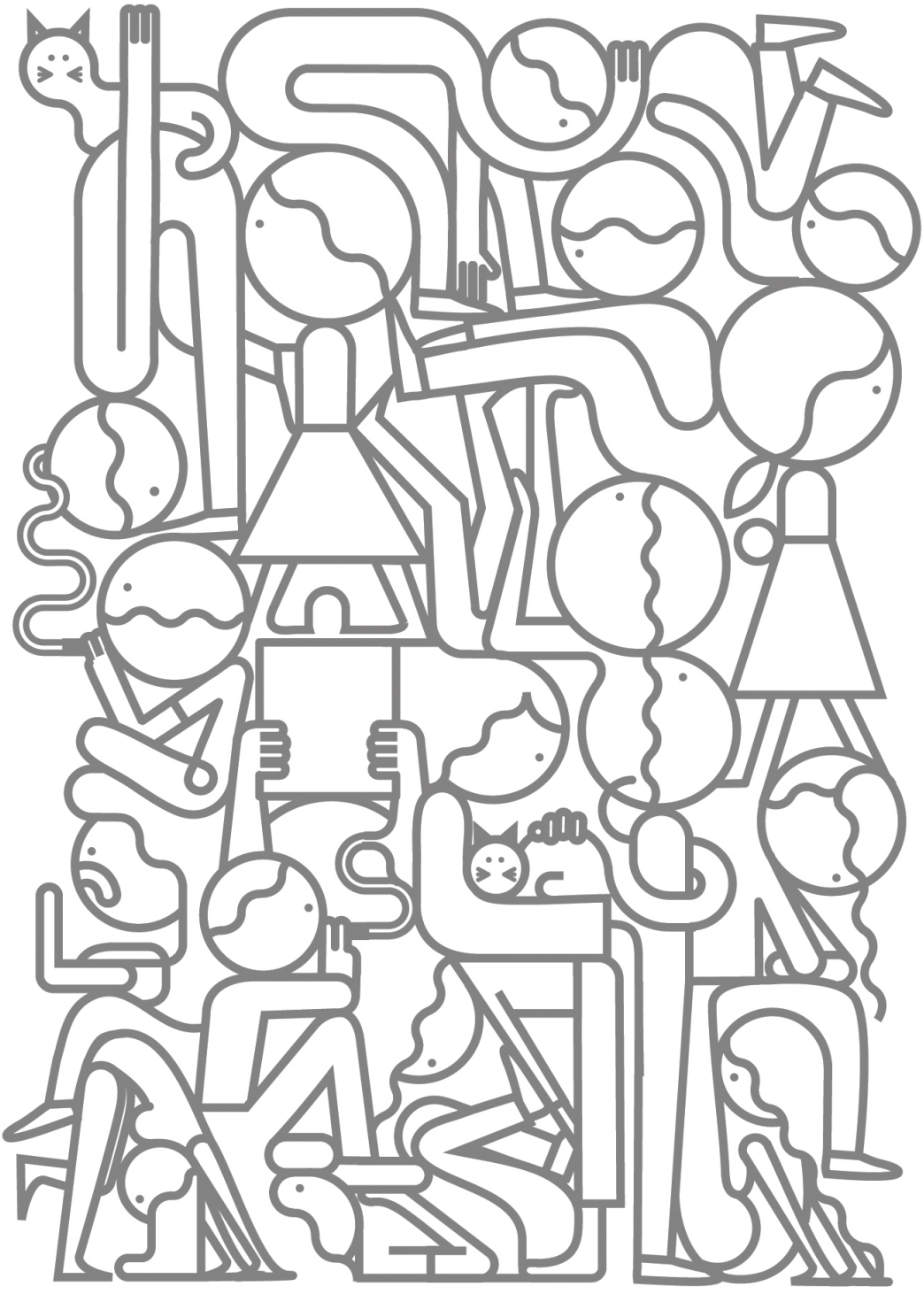


Chapter 1

Introduction

Early childhood is a critical period for language learning. A vocabulary spurt is particularly evident in the preschool years. Vocabulary is essential for children to understand the world around them, communicate with others, and to learn to read and write later on. At two to four years of age already large differences exist in the size and developmental rate of children's vocabularies (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994; Hoff, 2006). Vocabulary sizes may vary from hundreds to thousands of words (Dungen, 2008; Kuiken, Vermeer, Appel, Kurvers, Litjes, Mooren, & Verhallen, 2005). It has been widely acknowledged that the family context and the verbal interactions children are involved in largely contribute to these differences (Hart & Risley, 1995; Hoff, 2006; Rowe, 2012). Less clear is which role characteristics of the child, such as their executive and social functioning, play in explaining vocabulary variation, even though these abilities seem essential to focus on linguistic input and to uphold social interaction.

Children with smaller vocabularies are at risk for falling behind and starting formal schooling with delays. Family literacy programs aim to support children's vocabulary by training parents' interaction behavior and providing language stimulating activities to be conducted at home (Sénéchal & Young, 2008). Although these programs generally have positive effects, vocabulary gains are relatively small because programs seem to insufficiently change parents' interaction behavior at home (Van Steensel, McElvany, Kurvers, & Herppich, 2011). The aim of the present dissertation was to further explain variation in preschool children's vocabulary, and to investigate whether alternative approaches to deliver a family literacy program have the potential to foster children's vocabulary development.

Early vocabulary development

From birth onwards children start building up their semantic network. The semantic network is a complex web in which different aspects of words, such as form, meaning and function, are stored (Nation, 1990). Vocabulary items exist on a continuum from not knowing a word on the one end, to being able to use a word appropriately in a sentence on the other end (Nagy & Scott, 2000). From this incremental view of learning, receptive vocabulary (understanding words) precedes productive vocabulary (using words). To acquire vocabulary, children need to encode the linguistic input stream by clustering the perceived sounds. Using the world around them, they learn that a combination of sounds has a certain meaning that refers to an object, situation or emotion. They

match the sound cluster, the phonological representation, to a referent. This link between the phonological representation and the referent is first stored in children's working memory and subsequently in their long-term memory (Sénéchal, Thomas, & Monker, 1995). By receiving linguistic input, children further develop their receptive representations of words; they acquire more details about the phonological form and refine hypotheses about possible meanings (Hoff, 2003a).

When the receptive representation of a word is stored, children can start using the word productively. Therefore, children must retrieve a word with its phonological and semantic representation from their long-term memory, hold it in working memory, articulate the sounds and use it within the appropriate context. Through the cognitive processes of encoding, storage and retrieval children develop a fine grained semantic network (Gathercole & Adams, 1993; Sénéchal et al., 1995). Because all different aspects of words are interconnected in the semantic network, receptive and productive vocabulary can develop very quickly. As the semantic network expands, children become less dependent of concrete objects or situations and can more easily connect novel vocabulary to what is already known. The more words children know, the easier they can connect novel words (Thorn, Frankish, & Gathercole, 2009).

Parent-child interaction and vocabulary development

Early vocabulary development is considered an informal learning process that takes place through verbal interactions with parents, family members, peers and teachers. Verbal interactions with parents are believed to play a key rol in the vocabulary development of preschool children, because at this age, children spend most of their time at home (Bronfenbrenner & Morris, 1998; Hoff, 2003a, 2006; Snow, 1994). Through parent-child interaction children receive both language input and opportunities to create output, which enables them to build up receptive and productive vocabulary. Two features of parent-child interaction are known to facilitate this process: The amount and quality of linguistic input and parents' sensitive responsiveness.

Linguistic input

The quality of linguistic input can be defined by the type of speech (e.g., use of contextualized versus decontextualized language) and the amount of talk (Rowe, 2012; Van Kleeck, 2008). Parents can use contextualized language about the here and now, which includes labeling and describing characteristics of objects that are perceptually present. This type of language is important for meaning creation of novel words, as it provides children with a direct connection between a phonological representation and a concrete referent. Contextualized input often results in relatively repetitive and simple child output, consisting of familiar, high-frequency words, many of which are nouns (Westby, 1991). Decontextualized language includes language beyond perceptual presence, for example talking about absent persons or objects in the past or future. This type of language is more challenging and demanding, and requires the child to make inferences and draw conclusions from context. Decontextualized language input leads to more detailed and dense language output of the child, comprising sophisticated vocabulary, including nouns, verbs, adverbs and conjunctions (Benson, 2009).

The latter type of language especially facilitates vocabulary growth and expansion of links within the semantic network. The representations of words become richer because the child experiences that words can be used within different contexts in combination with different words (Demir, Rowe, Heller, Goldin Meadow, & Levine, 2015). The extent to which children are involved in contextualized and decontextualized language is important for vocabulary development. The quantity of parental language input is a strong predictor for the rate of vocabulary growth. The more children are exposed to language and the more opportunities are offered to use language, the faster their receptive and productive vocabulary develops (Hart & Risley, 1995; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Rowe, 2012).

Parent sensitive responsiveness

A second important aspect for parent-child interaction to facilitate vocabulary development is the degree with which parents adjust linguistic input to their child's emotional and cognitive needs. In attachment theory, this is referred to as sensitive responsiveness (Ainsworth, Blehar, Waters, & Wall, 1978; Landry, Smith, & Swank, 2006). Emotional support and secure attachment are considered prerequisites for parent-child interaction and learning to take place. A sensitive and supportive style is characterized by parents providing warmth and acceptance. Sensitive parents encourage their child to participate in activities

and provide supportive comments (Landry et al., 2006). It also consists of respect for children's autonomy by treating them as unique individuals (Erikson, 1950) and providing clear expectations of children's behavior by providing structure and limiting settings (Roberts, Jergens, & Burchinal, 2005; Thompsom, 1998).

Moreover, sensitive behavior includes that parents adjust their linguistic input to the child's cognitive abilities. If the child is cognitively not able to make inferences, the parent should attune its input and use contextualized language instead. The same holds the other way around; if the child is in need for more challenging language input, the parent should not adhere to contextualized questions but increase demands and use decontextualized language instead. Adjusting linguistic input to the child's cognitive abilities prevents the child for becoming frustrated and demotivated about doing activities together (Landry et al., 2006; Van Kleeck, Gillam, Hamilton, & McGrath, 1997). A sensitive responsive interaction style, both on the emotional and cognitive level, has shown to be an important aspect of parent-child interaction for the development of early vocabulary (De Jong & Leseman, 2001; Roberts et al., 2005).

Variation in parent-child interaction and early vocabulary development

All parents want their children to develop rich vocabularies to succeed in school later on. Yet some parents provide their children with more support than others. Example 1 illustrates how parents differ in the way they interact with their child. In this example, parent-child dyads are discussing an illustration about a barbecue in the garden. The linguistic input that parent A provides is characterized by open-ended questions that challenge the child by going beyond what is perceptually present on the illustration. The parent asks the child to make predictions about the actions of the father and asks the child for its opinion. As a result, the child creates a rich mental representation of the barbecue setting including information about its own personal context. Moreover, the child activates words of which the referent is not visible (salmon). In contrast, parent B uses simple and short sentences which are mainly what- and yes-or-no-questions, that ask the child to label objects. The parent does not elicit elaborate answers and rich linguistic output. Moreover, the parent focuses on what is perceptually present on the illustration and does not make inferences to the context outside of the illustration. The linguistic input of parent A is of higher quality and better adjusted to the child's level, compared to the input of parent B. As a result, child B is likely to develop its vocabulary at a slower rate.

Example 1

Two parent-child dyads while discussing an illustration about a barbecue in the garden

Dyad A		Dyad B	
Parent	What is daddy going to do after barbecuing?	Parent	Let's have a look
Child	Making a sandwich	Parent	What is this?
Parent	And what do you think he will put on the sandwich?	Child	Food
Child	Butter, and sausages	Parent	Are they eating?
Parent	Why is he doing that?	Child	Yes
Child	He likes sausages	Parent	What do you see here?
Parent	Does your daddy also like sausages?	Child	Sausages
Child	Yes!	Parent	Sausages
Parent	And do you also like sausages?	Parent	That's a barbecue, right?
Child	Yes!	Child	Yes
Parent	What is your favorite food?	Parent	And what is this?
Child	Salmon	Action	Child points
Parent	Just like your brother	Parent	What is in there?
Child	Just like pizza and sausages	Child	An apple

The variation in the quality of parent-child interaction and the size and rate of children's vocabulary can be approached via two models (Hoff, 2006). The first approach is the bioecological model of development that focuses on the shaping role of the social context in which children live (Bronfenbrenner & Morris, 1998). The social context is defined as different nested systems where the child is part of. The most distal system includes for example culture, which influences the more proximal systems, such as the school and family context. Verbal interactions that take place within the child's proximal system are viewed as the primary 'engines of development' (Bronfenbrenner & Morris, 1998, p. 996). The second approach focuses on the internal processes underlying language development. It departs from the conceptualization that language development is a product of the child's mental processes. From this view, the mental processes in the child's head use information from the environment as their input (e.g., Chomsky, 1965; Hoff, 2003a).

The family context

Departing from the first approach, children's vocabulary is shaped by characteristics of the family context, such as the amount of language related activities taking place at home, parents' educational level and degree of self-efficacy, and the language(s) spoken at home. In the first place, the child must

be offered opportunities to participate in language stimulating activities. These are activities such as shared reading, singing songs and rhymes, but also daily routines that parents transform in a language stimulating activity, for example, counting clothes or naming colors while helping with the laundry (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). The frequency with which children are involved in these types of language related activities at home is strongly associated with their vocabulary (Bus, Van IJzendoorn, & Pellegrini, 1995; Ebert, Lockl, Weinert, Anders, Kluczniok, & Rossbach, 2013).

In general, lower educated parents have fewer language stimulating materials (such as picture books and puzzles) available at their homes and tend to involve their child in fewer language stimulating activities compared to higher educated parents (Hoff, 2003a, 2006). An important aspect in this is the degree of self-efficacy; parents' beliefs about their capacities to control their own functioning and environmental demands (Bandura, 1986). Parents with a lower educational level often feel themselves less able to influence their child's development and behavior (Bandura, 1986; Seefeldt, Denton, Galper, & Younoszai, 1999). As a result, they involve their child in fewer activities in comparison with parents who believe that their involvement makes a difference (Walker, Wilkins, Dallaire, Sandler, & Hoover-Dempsey, 2005).

There also appear to be differences in the quantity and quality of verbal interactions across lower and higher educated parents. Lower educated parents tend to have smaller vocabularies and lower language skills themselves, resulting in more concrete and contextualized language about the here and now with their children (Van Kleeck et al., 1997; Van Kleeck, 2008; Rowe, 2012). In contrast, higher educated parents often have more sophisticated vocabularies and involve their child in challenging interactions. As a consequence, children growing up in lower educated families often have smaller vocabularies and develop vocabulary at a slower rate (Hoff, 2006).

Moreover, the languages spoken at home play an essential role in vocabulary development. Children growing up in linguistically diverse families with a minority language spoken at home, tend to have smaller vocabularies in both their L1 (first language) and their L2 (second language) (Kuiken et al., 2015). In the Netherlands, the majority of linguistically diverse children learn a minority language at home and the country's native language Dutch as soon as they enter preschool. These children receive less Dutch language input and therefore experience fewer opportunities to practice this language (Scheele, Leseman, & Mayo, 2010; Van Druten-Frietman, Denessen, Gijsel, & Verhoeven, 2015). Even though children's L1 language experiences are beneficial for their L2 language

development (Cummins, 1979), children that have to learn two languages at the same time or sequentially tend to have smaller vocabularies (Mancilla-Martinez & Vagh, 2013). Summing up, from the bioecological approach, there are some key characteristics of the social context in which children live that shape their vocabulary development.

Child executive and social functioning

The second approach emphasizes the influence of a child's mental processes and the factors involved in this for vocabulary development. Research has shown that next to children's age and gender, their executive and social functioning are important aspects for how linguistic input is perceived, processed and maintained (McClelland, Morisson, & Holmes, 2000; Weiland, Barata, & Yoshikawa, 2014). Children's executive functioning (EF) is defined as their ability to control and regulate cognitive and behavioral processes (Lezak, 1995; Mesulam, 2002). EF seems essential in children's initial language development (Garon, Bryson, & Smith, 2008; Weiland et al., 2014) because it allows them to focus on and process multiple streams of language input at the same time, monitor errors, and make decisions based on the available linguistic information (Diamond, 2013).

Important cognitive processes involved in learning vocabulary from verbal interaction include children's abilities to control their attention. Using inhibition skills children can focus their attention on relevant linguistic input by inhibiting attention to irrelevant and distracting information. Children also apply shifting competencies in order to flexibly shift their attention between different linguistic contexts (Diamond, Kirkham, & Amso, 2002). By shifting attention between contexts, they can derive word meanings corresponding to a particular context (Moriguchi, 2014; Weiland et al., 2014). During these attention control processes, children use their short-term memory to maintain and access information and their long-term memory to store new word meanings (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Gathercole & Baddeley, 1993). EF also help children to control their behavioral processes, for example, in overcoming that they say the first thing that comes to their mind (Moriguchi, 2014). Research has shown that EF play an important role in early vocabulary development.

Along with children's EF, their social functioning (SF) is a factor involved in their mental processes. SF enables children to initiate, participate in and maintain interaction with their parents, other adults and peers. These skills are vital for generating language input and output (McClelland et al., 2000; Vitiello & Williford, 2016). SF includes several skills, such as the ability to take perspectives, understand feelings of others and take into account differences

and similarities between themselves and others. These abilities are necessary for children to interact positively, listen to others, play collaboratively and share and take care of others (Denham & Brown, 2010). During the preschool ages, children are developing insights in their own and others' interactional behavior. Gradually, they develop an understanding of the reciprocal nature of social interaction, as they find out that communication is a matter of giving and receiving (Feldman, Bamberger, & Kanat-Maymon, 2013).

Studies have shown that SF competencies are essential to successfully participate in preschool (Denham & Brown, 2010). At school, children are for example required to follow directions of their teachers. Children with developed SF are more likely to enjoy school and perform well on academic tasks. Children with higher levels of SF engage in more conversations with adults and peers which in turn facilitates the development of receptive and productive vocabulary (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; McClelland et al., 2000; Vitiello & Williford, 2016; Ziv, 2013).

Family literacy programs

One way to anticipate on vocabulary differences between children and to support children's early vocabulary development, is by supporting verbal interaction skills of parents. Family literacy programs aim to foster children's vocabulary by enhancing parent-child interactions. Within these programs parents are trained how to interact with their child (i.e., how they can increase linguistic input quality and apply a sensitive responsive attitude) and how they can involve their child in language activities (Sénéchal & Young, 2008). Family literacy programs focus on training of interaction skills via parent group meetings or home visits. This is combined with attention for the cognitive and social development of children by providing stimulating materials (such as story books, craft materials and memory games). Via this approach, family literacy programs aim to make permanent positive changes in a family's routine and aim to promote vocabulary on the long-term (McElvany & Artelt, 2009; Van Steensel et al., 2011). It is generally believed that early investment creates opportunities for later on. Early interventions provide opportunities to intervene prior to the development of vocabulary differences and at a moment that children's cognitive and social skills are changing rapidly. Moreover, parents acquire interaction skills that they can keep on using as their child grows up.

Recent meta-analyses show that family literacy programs have positive effects of on children's vocabulary development; however, their impact remains limited (Blok, Fukkink, Gebhardt, & Leseman, 2005; Grindal, Bowne, Yoshikawa, Schindler,

Duncan, Magnuson, & Shonkoff, 2016; McElvany & Artelt, 2009; Van Steensel et al., 2011). It has been argued that these small effects may be related to the way these programs are delivered to parents and the amount of guidance and support that is offered to them. Often, parents are provided with information about the important aspects of their interaction behavior, without giving them the opportunity to practice and experience this behavior. This way of guidance might be insufficient for programs to establish the targeted behavioral change in the home environment (Grindal et al., 2016; McElvany & Artelt, 2009; Van Steensel et al., 2011). To increase the impact of family literacy programs, two alternative approaches to optimize delivery of a family literacy program to parents are investigated in this dissertation: active learning during groups meetings (AL) and technology-enhanced learning via a tablet computer (TL).

Active learning during group meetings

Active learning can be defined as involving parents 'in *doing* things and *thinking* about what they are doing' (Bonwell & Eison, 1991, p. 19). As opposed to passively listening to information provided by teachers, active learning involves parents in higher-order thinking about their own behavior (Kaminski, Valle, Filene, & Boyle, 2008). For active learning to take place, modeling of the proposed behavior can be a first step. When teachers model high quality linguistic input and a sensitive responsive attitude, for example via interactive story-book reading, parents can create a mental representation of the proposed behavior (Bandura, 1971). This behavior can be retained by actively bringing the observed behavior into practice, for example by pretend play, role plays and interactive discussions. Compared to passive listening, it is more likely that active learning increases high quality linguistic input and a sensitive responsive attitude in parents and that it changes their interaction behavior at home. Previous research found suggestive evidence for family literacy programs in which interaction behavior was systematically modeled and practiced with parents. It was associated with greater effects on children's pre-academic skills (such as reading, counting and letter recognition) (Grindal et al., 2016). The present dissertation contributes to this by examining effects of a family literacy program with active learning activities using an experimental design.

Technology-enhanced learning

A promising alternative to existing ways to optimize parental support is to draw on widely-used technology. By the time young children enter formal schooling, they are very likely to have experienced several digital forms of communication,

such as phones and tablet computers (Labbo & Reinking, 2003). Despite the increasingly central role of digital devices in the family context, they have relatively little been used to improve the interactional quality within this context. Recently, research has established the significance and potential benefits of digital activities. For young children, mostly technology-enhanced storybooks were developed for children to read individually (for an overview, see meta-analyses of Takacs, Swart, & Bus, 2014, 2015). To our knowledge, no digital activities were developed with the purpose to support parents in their interaction behavior and to improve parent-child interaction.

Therefore, in the current dissertation a digital activity to improve parent-child interaction was designed. Based on several design principles that were shown effective in previous research, the technology-enhanced storytelling called Jeffy's Journey was developed. Technology-enhanced storytelling includes digital storytelling with real-time visual, auditory and textual interaction prompts. The design principles include different storytelling phases (Harris & Schroeder, 2012), the possibility to control a story line without a digital voice-over (Kim and Anderson, 2008), explicit turn regulation for parent and child (Therrien & Light, 2016) and visual, auditory and textual prompts corresponding to a storyline (Korat, Shamir, & Heibal, 2013). One of the expected advantages of technology-enhanced storytelling was that it would require no transfer of interaction behavior learned in a parent meeting to the home environment. It was expected that the real-time interaction support would facilitate sustained changes in parents' interaction behavior in the home. Within the family literacy program, technology-enhanced storytelling was used as an activity to teach the proposed interaction behavior and to transfer this behavior to other program activities.

Measuring effects of family literacy programs

In general, effects of family literacy interventions are measured by standardized vocabulary tests, such as the Peabody Picture Vocabulary test (Dunn & Dunn, 2005) or the Reynell Developmental Language Scales (Letts, Edwards, Schaefer, & Sinka, 2014). These standardized vocabulary tests are reliable measures that provide comparisons of children and age-matched peers as well as the effects of different programs. A disadvantage of these tests is that they lack to measure how children actually respond to an intervention because they do not comprise vocabulary test items that occur in the program. As a result, family literacy programs effects may be underestimated. Moreover, teachers and program developers do not receive information on what children learn

from their instruction or program. Therefore, curriculum-based tests can be a valuable measure in addition to the standardized test that measures general vocabulary.

Curriculum-based assessment refers to a test model that emphasizes a direct relationship between an intervention and children's development (Deno, 1985; Espin, Shin, Busch, 2005). It assumes that repeatedly measuring children's curriculum-based knowledge provides an evaluation of an intervention's effectiveness that allows for creating more effective teaching methods and increasing learning gains. As the use of curriculum-based vocabulary tasks in family literacy program impact studies has been very limited (Grindal et al., 2016; Van Steensel et al., 2011), in the current dissertation, this assessment model is used to identify how children's receptive and productive vocabulary develops when involved in a family literacy program.

Aims and research questions

There is a wide variation in the receptive and productive vocabularies of preschool children. It is unclear which role characteristics of the child, such as their executive and social functioning, play in explaining vocabulary variation within the broader family context, even though these abilities seem essential to focus on linguistic input and to uphold social interaction. Up until now, variation in early vocabulary has mainly been studied either from the bioecological perspective including family contextual factors, or from the internal processes perspective including the child factors. Limited attention has been paid to the integration of these two approaches and to the conjoint contributions of EF, SF and the family context to early vocabulary. Hence, the first aim of the present dissertation was to further explain variation in preschool children's vocabulary and to investigate how EF and SF contribute to vocabulary when taking into account family contextual factors. This is of importance because it provides insights into which children tend to fall behind and are in need for receiving additional support.

Family literacy programs aim to enhance children's vocabulary development by training parents' interaction behavior and providing language stimulating activities to be conducted at home (Sénéchal & Young, 2008). Although these programs have in general positive effects, vocabulary gains are relatively small because programs seem to insufficiently change parents' interaction behavior (Van Steensel et al., 2011). The second aim of the present dissertation therefore was to investigate vocabulary effects of two alternative approaches to deliver a family literacy program, to know, active learning (AL) and technology-

enhanced learning (TL). Central to the AL condition were active learning activities to deliver the family literacy program, such as modeling, pretend play, role play and interactive discussions. In the TL condition, technology-enhanced storytelling was used as an activity to teach the proposed interaction behavior and to transfer this behavior to other program activities. Figure 1.1 provides a schematic overview of the theoretical constructs involved in this dissertation.

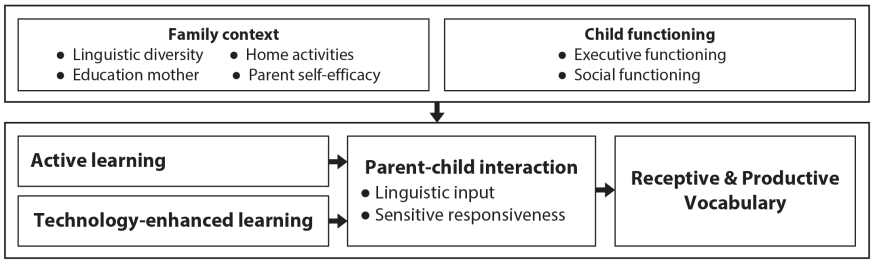
The family literacy program central in this dissertation was the Dutch program 'Early Education at Home' (In Dutch: *VVE Thuis*, developed by the Dutch Youth Institute, 2014). Key focus of this program is to enhance children's vocabulary by improving linguistic input quality and sensitive responsiveness of parents at home. Every six weeks parents attend a 1.5-hour parent group meeting during which they learn about the interaction behavior to be performed during home activities. In the meeting they receive a workbook with activities to be conducted at home (i.e., shared reading, storytelling activities, memory games, puzzles, songs and rhymes, arts and craft activities, and daily activities). The family literacy program is strongly aligned with the different programs used in preschools. The family literacy program and preschool programs offer the same six-weekly themes and content at the same time.

Effects of AL and TL on children's vocabulary were measured by a general vocabulary task and receptive and productive curriculum-based tasks. This allowed for drawing robust conclusions about both children's general knowledge and how children respond to the program. The following two research questions are addressed in this dissertation:

1. How can the variation in preschool children's vocabulary be explained from the family context and the child's functioning?
2. Are active learning (AL) and technology-enhanced learning (TL) effective ways to deliver a family literacy program and foster children's vocabulary development?

Figure 1.1

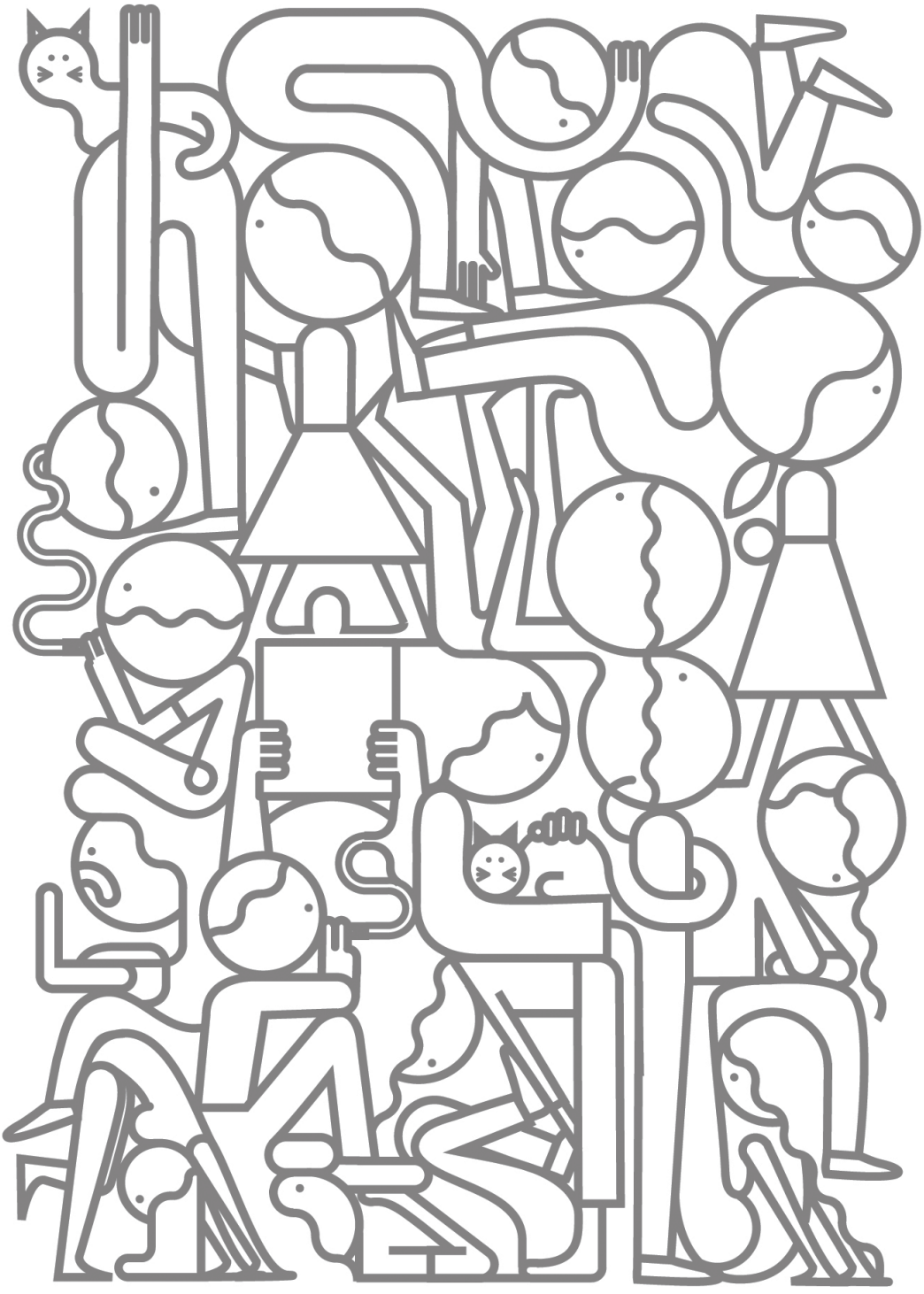
Overview of the theoretical constructs involved in this dissertation



Outline of the present dissertation

In order to answer the first research question, children's initial vocabulary at the beginning of preschool and vocabulary development over the schoolyear were addressed. Chapter 2 presents a study in which the extent to which executive and social functioning predict initial preschool vocabulary is examined, while taking into account family contextual factors. In Chapter 5, differential vocabulary development over the schoolyear is addressed.

To answer research question two, three studies were conducted. Chapter 3 presents an experiment on the newly developed technology-enhanced storytelling activity. In this chapter, three important topics are addressed: involvement of parents and children in technology-enhanced storytelling, the relation between application use and parent-child interaction, and the effects of the application on children's receptive and productive vocabulary. In Chapter 4 and 5, the results of a one-year intervention study are presented. Chapter 4 focuses on vocabulary effects of a family literacy program with AL and TL after one schoolyear. In this chapter, both curriculum-based receptive, productive and general vocabulary development are included as outcome variables. Chapter 5 further elaborates on program effects by zooming in on effects of the interventions during the schoolyear and focusing on curriculum-based vocabulary development. In this chapter it is also addressed whether program effects differ depending on the child's executive and social functioning and the family context. In the final chapter, Chapter 6, the key findings of this dissertation are discussed, including the overall theoretical and practical implications, limitations and directions for future research.



Chapter 2

Children's executive and social functioning and family context as predictors of preschool vocabulary

Based on

Teepe, R. C., Molenaar, I., Oostdam, R. J., Fukkink, R. G., & Verhoeven, L. (2017). Executive and social functioning and family context as predictors of preschool vocabulary. *Learning and Individual Differences, 57*, 1-8. Doi: 10.1016/j.lindif.2017.05.012

Abstract

The primary source for young children's vocabulary development is parent-child interaction. How parent-child interaction influences vocabulary depends on the child's functioning and the family context. Although research shows the effect of the family context on vocabulary (e.g., reading activities at home, parental education), the role of a child's functioning has received less attention. Children's executive functioning (EF) influences how linguistic input is processed and their social functioning (SF) is important for maintaining social interaction. The aim of the present study was to investigate the additional contributions of children's EF and SF to vocabulary. EF, SF and family contextual factors were measured in 223 Dutch preschool children. EF and SF strongly predicted children's vocabulary in addition to their age, linguistic diversity at home and parental education. EF and SF are therefore important factors to take into account when investigating vocabulary and vocabulary interventions in preschool children.

Introduction

Children's vocabulary development is an informal learning process that takes place through interactions with adults (Leseman & De Jong, 1998). Considering the large amount of time a preschool child spends at home, their primary source for language input and practice is verbal parent-child interaction (Snow, 2006). Parent-child interaction differentially affects a child's vocabulary depending on child functioning and of the family context in which it occurs (Bronfenbrenner & Morris, 1998). Even though the influence of the family context on preschool vocabulary has been well established; less attention has been given to how child functioning influences vocabulary development. The family context, including educational level and linguistic diversity has been found to have a great impact on vocabulary development (e.g., Ebert, Lockl, Weinert, Anders, Kluczniok, & Rossbach, 2013; Hoff, 2006; Van Druten-Frietman, Denessen, Gijsel, & Verhoeven, 2015).

Moreover, there is growing evidence that a child's executive functioning (EF; the ability to control and regulate cognitive and behavioral processes) and social functioning (SF; successful initiation of interactions and relationships) play an important role in how that child acquires vocabulary from parent-child interaction (Diamond, 2006; McClelland, Morisson, & Holmes, 2000). Nevertheless, few studies have examined vocabulary while including a child's EF and SF in addition to the family context (Vitiello & Williford, 2016; Weiland, Barata, & Yoshikawa, 2014). Up until now vocabulary has mainly been studied from the perspective of the family or the child, but only limited attention has been paid to the integration of EF, SF and the family context (Ebert et al., 2013; Van Druten-Frietman et al., 2015). In the present study, we therefore addressed the role of EF and SF in predicting preschool children's vocabulary in addition to the family context. Identification of how children's EF and SF at an early age contribute to vocabulary could provide insights into improving intervention programs that aim to facilitate children's vocabulary at home.

Vocabulary in the family context

From a social constructivist perspective, vocabulary development is, fundamentally, a social process that takes place via verbal interactions with others (Leseman & de Jong, 1998). Therefore, several aspects of the family context are important for a preschool child's vocabulary. In the first place, a child must be offered opportunities to participate in language stimulating activities, such as shared book reading or singing songs and rhymes (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). The frequency with which a child is

involved in these types of activities at home is correlated with their vocabulary (Bus, Van IJzendoorn, & Pellegrini, 1995). In general, lower educated parents engage in fewer reading activities with their child (Hoff, 2006; Scarborough & Dobrich, 1994), which is related to the degree of their self-efficacy (parents' beliefs about their capacities to control their functioning and environmental demands) (Bandura, 1986). Parents with a lower level of education often feel themselves less proficient in influencing their child's development and behavior (Bandura, 1986; Seefeldt, Denton, Galper, & Younoszai, 1999) and are therefore less likely to be involved with their child than more highly educated parents who often believe their involvement will make a difference (Walker, Wilkins, Dallaire, Sandler, & Hoover-Dempsey, 2005).

Secondly, acquiring vocabulary from these home activities is facilitated by other more experienced adults who, in case of preschool children, are often the parents (Rogoff, 1990). The quality of verbal interaction between a parent and child plays an especially important role in vocabulary development (Rowe, 2012). Often, lower educated parents have lesser language skills, using more concrete language about the here and now and less abstract language about what is beyond perceptual presence (Van Kleeck, Gillam, Hamilton, & McGrath, 1997). Moreover, children growing up in linguistically diverse families, with a minority language spoken at home, receive less language input in the native language of the country that they are growing up in and therefore experience fewer opportunities to practice this language (Scheele, Leseman, & Mayo, 2010; Van Druten-Frietman et al., 2015). Even though children's prior language experiences (L1) are beneficial for learning a second language (L2) (Cummins, 1979), L2 children tend to have smaller vocabularies in L2 compared to their peers for whom that language is L1 (Mancilla-Martinez & Vagh, 2013). As a result, children from lower educated parents with limited self-efficacy and children speaking a minority language at home often have smaller vocabularies and develop vocabulary at a slower rate (Hart & Risley, 1995; Hoff, 2006; Seefeldt et al., 1999).

Even though the influence of the family context on vocabulary has been well established over the past decades (Ebert et al., 2013; Hart & Risley, 1995; Hoff, 2006; Van Druten-Frietman et al., 2015), less attention has been paid to the child's functioning and how this influences parent-child interactions and vocabulary. Often age and gender are included in analyses, with older children showing greater vocabularies and little or no difference between preschool girls and boys (Ebert et al., 2013; Van Druten-Frietman et al., 2015). Along with age and gender, vocabulary is considered to be influenced by a child's functioning,

that is to say their executive and social functioning (Diamond, 2006; McClelland, Morisson, & Holmes, 2000). These abilities allow a child to control and regulate the verbal input provided and are considered to be essential for participation in social situations.

Executive functioning and vocabulary

Vocabulary acquisition in young children via social interactions seems to depend on their executive functioning (EF). EF is defined as their ability to control and regulate their cognitive and behavioral processes (Lezak, 1995; Mesulam, 2002). EF can be viewed as a multidimensional concept involving the interrelated components of working memory, response inhibition and attention shifting (Diamond, 2013; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000). Working memory is the ability to hold information in mind and allows the information to be retained for learning (Gathercole & Baddeley, 1993). Response inhibition is the ability to suppress prepotent responses and allows children to control and suppress automatic, impulsive behaviors and to carry out less automatic responses in their place (Diamond, Kirkham, & Amso, 2002; Weiland et al., 2014). Attention shifting refers to children's ability to flexibly shift to a new situation or another mind set (Garon, Bryson, & Smith, 2008). These skills start developing around the age of one and improve substantially during the preschool years (Welsh, Nix, Blair, Bierman, & Nelson, 2010). It is now widely acknowledged that, in three-year-old preschool children, the different EF components form a unitary construct (Barata, 2011; Fuhs & Day, 2011; Wiebe, Espy, & Charak, 2008; Wiebe et al., 2011). When children become older, the separate components become more clearly differentiated and develop into distinct mental abilities (Miyake et al., 2000; Tucker-Drob, 2009). As EF is a unitary construct formed by multiple components, a multiple task approach is desirable to achieve a reliable EF score in preschool children (Wiebe et al., 2011).

Empirical studies have shown that EF in preschool children supports the development of vocabulary (McClelland et al., 2000; Weiland et al., 2014). Children with greater EF skills in preschool had larger vocabularies in preschool and elementary school. EF seems to be essential for children's initial language development. It helps them to focus on and process multiple streams of language input at the same time, monitor errors, and make decisions based on the available linguistic information (Diamond, 2013). In order to abstract meaning from social interaction, children use shifting, inhibition and memory abilities at the same time. For example, they shift attention between contexts to derive word meanings corresponding to a particular context, they focus

on the relevant linguistic input by suppressing attention to irrelevant and distracting input, and they hold phonological representations of words in mind and store them in their long-term memories (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Moriguchi, 2014; Weiland et al., 2014). Moreover, EF facilitates social interactions because it helps children to overcome saying the first thing that comes into their head (Moriguchi, 2014). Controlling and regulating their behavior in social interactions allows children to obtain the linguistic input that they require in order to expand their vocabulary. Recent research has shown the contribution of EF to children's communicative behavior and vocabulary (Moriguchi, 2014; Weiland et al., 2014). However, the (relative) contribution of EF to vocabulary is still unclear because it has not been considered in conjunction with children's social functioning and in relation to the family context.

Social functioning and vocabulary

Along with EF social functioning is considered necessary for the word learning process. Children's social functioning (SF) enables them to initiate, participate in and maintain interaction with their parents, other adults and peers, which is essential for generating language input and to practice language (McClelland et al., 2000; Vitiello & Williford, 2016). SF includes, for example, pro-social behavior in which children interact positively, play collaboratively and share and take care of others. SF is especially important in understanding the reciprocal nature of interactions and the integration of input from parents and children into a coherent social event (Feldman, Bamberger, & Kanat- Maymon, 2013). Reciprocity changes over the course of the preschool years with a gradual shift from greater amounts of parental reciprocity, with the parent adapting to the child, to a more balanced giving and receiving. Gradually, the child develops an understanding of the reciprocity of communication, including their own contribution. SF forms the basis for the quality and quantity of child-parent interaction. Children with higher levels of SF engage in more conversations with adults and peers (McClelland et al., 2000). Studies have also shown that stronger SF at preschool relates to better learning and greater gains in vocabulary (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Vitiello & Williford, 2016; Ziv, 2013). However, the relative importance of SF needs further study to establish its role in vocabulary in conjunction with EF and taking into account the family context.

This study

The aim of this study was to examine the role of the children's EF and SF in predicting preschool vocabulary in addition to the family context. The influence of the family context on preschool vocabulary has been well established with the parents' educational level, their self-efficacy, and the language spoken at home being important (Ebert et al., 2013; Hoff, 2006; Van Druten-Frietman et al., 2015). However, the supplementary role of child functioning has received little attention to date. After a child's age and gender, their EF and SF are expected to play an important role in vocabulary (Diamond, 2006, 2013; Weiland et al., 2014). EF is assumed to contribute to the processing of linguistic input and SF to being able to uphold social interaction. Despite the perceived importance of EF and SF as stressed in recent theories, few studies have addressed their contribution to preschool vocabulary and, those that have, paid limited attention to the family context (Weiland et al., 2014). Vocabulary has mainly been studied from the perspective of the family or the child without a clear focus on the integration of EF and SF (Ebert et al., 2013; Van Druten-Frietman et al., 2015). Therefore, we investigated the extent to which EF and SF predict preschool vocabulary, while taking into account children's age and gender and family contextual factors linguistic diversity, parent education, reading activities at home and parent self-efficacy.

First of all we expected to confirm the contribution of the family context to vocabulary (Ebert et al., 2013; Hoff, 2006; Van Druten- Frietman et al., 2015). In addition to the family context we hypothesized a contribution of both EF and SF to vocabulary. Children with better abilities to control and regulate their behavior were expected to have larger vocabularies (Moriguchi, 2014; Weiland et al., 2014). Furthermore, children who are engaged in more interactions may have more opportunities to increase their vocabulary (McClelland et al., 2000; Vitiello & Williford, 2016).

Method

Participants

The present study is part of the longitudinal project Parents in Preschool Education in the Netherlands. For this project, we approached Dutch preschool organizations, of which four agreed to participate with a total of 13 preschools (two to six per organization). All preschools met Dutch policy quality standards for preschool education (i.e., a maximum class size of 16 children, child-to-teacher ratio of 16:2, a certified Early Childhood Education (ECE) program and preschool teachers who received specialized ECE training). Preschools

were located throughout the Western provinces of The Netherlands. Each participating preschool had, on average, 17 children, ranging from eight to 30.

In the Netherlands, preschool is available for children at the age of 2 to 4. Children were selected based on their age (2;6 to 3;3 years of age), resulting in a total of 223 preschool children (*Mage* = 35.4 months, *SD* = 3.5) of which 43.5% (*n* = 97) were girls. At the time of testing, children had been attending preschool on average for 7.5 months (*SD* = 4.5 months, range: 0–15). Children were linguistically diverse and learned Dutch either as a first (L1) or second (L2) language. Children were defined as first language learners when only Dutch was spoken at home. When another other language was spoken at home, either by one or both parents, they were indicated as second language learners. The sample consisted of 108 L1 children (48.4%) and 115 L2 children. There was quite some variety in the L2 leaners' first language, with a total of 48 different languages and Moroccan, Turkish and Polish occurring most frequently. The ratio of L1/L2 children within preschools varied from 20.0% to 94.4% L2 children.

Highest education of the mother was used as a measure for educational level, based on maternal education being the most robust sociodemographic predictor of infant behavior. Especially at this young age, mothers exert the greatest influence on children's development (Bornstein, Hahn, Suwalsky, & Haynes, 2003). Educational level was measured on a six-point-scale ranging from no education (1) to university (6) and showed a mean of 4.4 (*SD* = 1.2). There was a small bias, as for one preschool (*n*= 18), the percentage of lower educated mothers was fairly high (33.3%), whereas for three other preschools (*n* = 18 to 25) the percentage of higher educated mothers was high (60% to 76.2%).

Measures

Vocabulary

The outcome measure of our study was the Dutch receptive Peabody Picture Vocabulary Test (Dunn & Dunn, 2005). In this task, the child was orally presented one target word at a time. Out of four pictures he/she had to select the picture corresponding to the target word. The test was finished when the child gave nine or more incorrect responses within a set of 12 items. Each item was scored as one point, with a maximum of 175 points.

Executive functioning (EF)

In line with previous research into preschool children's EF (Wiebe et al., 2011; Weiland et al., 2014), the EF concept was operationalized with multiple tasks measuring different dimensions that cluster into a unitary EF construct. Each task relied on a different but related EF component. Scores on the three components together formed a composite EF score (see Analysis).

In the *working memory* task, children had to repeat strings of common, Dutch one syllable words in the same order, starting with a one word-string until a maximum of a six word-string (Schlichting & Lutje Spelberg, 2010). The test was stopped after two consecutive mistakes. With one point for each correctly repeated word string, the maximum score was 13 points. Internal consistency was sufficient (Cronbach's $\alpha = 0.81$).

Response inhibition was measured by the Hand Game (Hughes, 1996). After an imitation phase during which children had to imitate six hand gestures (fist or flat hand) of the experimenter, the test phase started. At least five out of six imitation phase trials had to be correct in order to continue to the test phase. In the test phase, children had to make 15 hand gestures opposite to the experimenter's hand gesture (also fist or flat hand) and inhibit the pre-potent imitation response. Following the test and scoring protocol (Hughes, 1996), children passed this test (score of one) when they made a series of six correct responses within the 15 trials, and failed (zero-score) if they did not make a series of six correct responses. Internal consistency of the task was high (Cronbach's $\alpha = 0.90$).

Attention shifting was measured by the Dimension Change Card Sort (DCCS, Zelazo, 2006). Children were shown cards representing colored shapes (stars or cars) that could be sorted according to color or shape. In the pre-switch phase, children had to sort six cards according to one dimension (shape or color). Children needed to sort at least 5 out of six cards correctly to continue to the switch phase. In the switch phase, children had to shift to another mental set and sort the cards according to the other dimension (color or shape). Following the test and scoring protocol (Zelazo, 2006), a zero-score was assigned if children failed the switch phase (< 5 cards sorted correctly) and a score of one was assigned if they passed the switch phase. Internal consistency of the task was sufficient (Cronbach's $\alpha = 0.73$).

Social functioning (SF)

Children's SF was measured by the Dutch KIJK! observation scale for preschool children (Van den Bosch & Duvekot-Bimmel, 2012) that was completed by their preschool teacher. The observation scale consisted of fifteen statements on how children behave with respect to peers and teachers (for example, 'the child is able to share with other children'). Items were scored on a 3-point-scale including 'not true', 'partly true' and 'entirely true'. Internal consistency was high (Cronbach's $\alpha = 0.90$) which is in line with the validated kindergarten version (Van den Bosch & De Jaeger, 2000).

The family context

Three questionnaires were administered to families. Questionnaires were filled out by one of the parents, in most cases the mother (86.1%). Questionnaires were available in Dutch and English. If parents had questions they were helped by translating or explaining unknown words.

The *demographic information* questionnaire contained questions about the parents' educational level, the language(s) spoken at home (to determine linguistic diversity, whether Dutch was the child's L1 or L2) and the child's gender and date of birth.

The frequency of *reading activities at home* was identified by a parent self-reported questionnaire, based on the questionnaire of Griffin and Morrison (1997). The reading activities questionnaire used in the current study (see Appendix A1) consisted of eight items in total asking about the parent's reading activities (for example: 'How often do you read a book?') and the child's reading and educational activities (for example: 'How often does your child play educational games, such as memory and puzzles?'). Items were scored on a 3-point-scale; 'never', 'sometimes' and 'often'. After deleting one item because of low reliability ('How often does your child play digital educational games?'), Cronbach's α was 0.60. The mean score of the seven remaining items was the final score.

Parent self-efficacy was measured by an adapted version of the Parent Self-Efficacy Questionnaire (Walker et al., 2005) filled out by the parent. After translation into Dutch, the questionnaire was simplified (shorter sentences with easier vocabulary) to make it understandable for lower educated parents and parents with limited Dutch language proficiency. Parent self-efficacy (see Appendix A2) consisted of seven items and contained questions on parent's nurturing feelings such as 'I know how to help my child when they have to learn new things'. Items were scored on a 3-point-scale consisting of 'no', 'a little' and 'yes'. After deletion of one item ('I am more influential for my child than the

preschool teachers'), Cronbach's α was 0.54 and item-total correlations were above $r = 0.20$, indicating that items were measuring the same construct.

Procedure

The first period of data collection was in autumn 2015, when the majority of children had just entered preschool. Children were individually tested in a quiet place outside the classroom by test-assistants. Eight test-assistants were trained and followed strict testing protocols. Testing took place within two separate sessions. After an instruction phase, children completed the vocabulary and EF tasks. Even though test-assistants first spent some time with the children in the classroom to familiarize themselves with the children, some children were distressed during test-administration and started to cry or refused to participate. This resulted in failure to administer the test. At the time of testing, parents and teachers completed the questionnaires. All parents gave active consent for their child's and their own participation. The study was approved by the Ethics Committee for Behavioural Research of Radboud University (dossier ECG2013-0606-116).

Analysis

Preliminary analyses were conducted to ensure no violation of the assumptions of normality and homogeneity of variance. A composite EF score was then calculated with the multiple tasks to measure this unitary construct. Principal Component Analysis with Varimax Rotation showed one underlying factor with an eigenvalue > 1, explaining 42.6% of the total variance. Component loadings were 0.57 (working memory), 0.74 (response inhibition) and 0.64 (attention shifting). The composite score was calculated by adding up the z-score of the working memory task and the dichotomous scores of response inhibition and attention shifting. This was then divided by the number of tasks ((zmemory + response inhibition + attention shifting) / 3).

Subsequently, missing data was analyzed. Of 223 children, one child was absent due to vacation. Failed test administration resulted in missing data at the PPVT (7.2%), working memory (8.1%), complex response inhibition (14.3%), and attention shifting (4.9%). Of 223 distributed SF questionnaires, 201 were returned (90.1%). All demographic information was complete, as these questionnaires were part of the informed consent form that was a prerequisite for participation. Return rate of the questionnaires reading activities at home and parent self-efficacy was 98.2%. A missing value analysis indicated that data were missing completely at random (Little MCAR-test: $\chi^2 = 220.846$, $df = 225$, $p = 0.566$). Therefore, missing data

were replaced using the Expectation-Maximization algorithm (Dempster, Laird, & Rubin, 1977) in SPSS 22 (IBM Corp, 2013).

As our goal was to examine the impact of EF and SF while taking into account the child's age and gender and the family context, a hierarchical regression analysis was conducted. In the first model, we entered children's age and gender and family contextual factors (linguistic diversity, education of the mother, reading activities at home and parent self-efficacy) to test their contribution to vocabulary. EF and SF were subsequently included in the second and third step respectively to investigate their additional contributions.

In order to compare the relative contribution of the predictor variables and to facilitate interpretation of the results, both standardized β-values and unstandardized Beta-values were analyzed. As the data has a nested structure with children in preschools, multilevel analysis was applied. A two-level model with preschool and child level had a significantly better fit than a one-level model with child level only ($\Delta{-}2LL = 6.791$, $df = 1$, $p = 0.009$). Even though the intra-class correlation was small with $\rho = 0.08$, Kreft and De Leeuw (1998) demonstrated that even small values may inflate the alpha level resulting in an increased chance of a Type I error. All multilevel analyses were carried out using MLwiN version 2.35 (Rasbash, Steele, Browne, & Goldstein, 2009).

Results

Descriptive statistics

Table 2.1 presents the descriptive statistics for outcome and predictor measures. The response inhibition and shifting tasks had relatively low success rates. On the response inhibition task, only 9% of the children succeeded and on the shifting task, only 14.3% succeeded. Because this was the first data collection period of a longitudinal study and most children were under three years old, it was expected that these skills had not yet developed in the majority of children (Carlson, Moses, & Claxton, 2004; Carlson, 2005; Garon et al., 2008).

Table 2.2 presents bivariate Pearson's correlations between all study variables. All predictor variables significantly related to vocabulary with moderate positive associations, except for the child's gender ($r = 0.09$, $p = 0.165$) and mother's education ($r = 0.12$, $p = 0.071$). Strong associations were found between vocabulary scores and linguistic diversity at home ($r = 0.50$, $p < 0.001$), EF ($r = 0.56$, $p < 0.001$) and SF ($r = 0.50$, $p < 0.001$).

Table 2.1

Means and standard deviations for outcome and predictor measures (N = 223)

		Mean	SD	Min-max
Outcome	Vocabulary	26.6	15.7	1-71
Predictors	Child age in months	35.4	3.5	23-44
	Child gender (girls)	43.5%		0-1
	Family context			
	Linguistic diversity (L2)	51.6%		0-1
	Education mother	4.4	1.2	1-6
	Reading activities at home	2.5	0.3	1-3
	Parent self-efficacy	2.7	0.3	1-3
	Executive functioning	0.1	0.4	-.6-1.2
	Working memory	4.1	2.3	0-12
	Response inhibition[1]	9%		0-1
	Attention shifting[1]	14.3%		0-1
	Social functioning	2.4	0.5	1-3

[1] Note: As the inhibition and shifting measures were dichotomous (fail vs. succeed), the percentage of children that succeeded is reported.

Table 2.2

Bivariate Pearson's correlations between study variables (N = 223)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Outcome									
1. Vocabulary	1								
Predictors									
2. Child age	.34**	1							
3. Child gender	.09	.03	1						
4. Linguistic diversity[1]	.50**	.09	.07	1					
5. Education mother	.12	.06	-.14*	.05	1				
6. Reading activities	.32**	.07	.10	.35**	.10	1			
7. Parent self-efficacy	.28**	.04	-.01	.30**	.05	.38**	1		
8. Executive functioning	.56**	.37**	.10	.33**	.03	.26**	.20**	1	
9. Social functioning	.50**	.26**	.17**	.32**	-.02	.24**	.26**	.53**	1

[1] reference category is L1

Executive and social functioning predict preschool vocabulary

Results of the multilevel analysis are presented in Table 2.3. The first model, including the child's age and gender and the family context, showed that children's age ($\beta = 0.08$, $p < 0.001$), linguistic diversity ($\beta = 0.82$, $p < 0.001$) and mother's educational level ($\beta = 0.10$, $p = 0.028$) significantly predicted children's vocabulary, whereas the child's gender ($\beta = 0.12$, $p = 0.276$), reading activities at home ($\beta = 0.30$, $p = 0.107$) and parent self-efficacy ($\beta = 0.37$, $p = 0.080$) did not. Thus, L1 children had higher vocabulary scores than their L2 peers and older children and children with more highly educated mothers scored higher.

In the second model, EF was added. EF significantly predicted vocabulary ($\beta = 0.90$, $p < 0.001$). Children with higher EF scores had higher vocabulary scores. By including EF in the model, R^2 increased from 0.38 to 0.48. In the third model SF was included. SF significantly predicted vocabulary ($\beta = 0.48$, $p < 0.001$). More social children had higher vocabulary scores. Adding SF to the model accounted for an R2 increase of 0.02, with a total R^2 of 0.50. In this final model, EF was the strongest predictor of vocabulary ($\beta = 0.67$, $p < 0.001$), followed by linguistic diversity at home ($\beta = 0.62$, $p < 0.001$) and SF ($\beta = 0.48$, $p < 0.001$). As in the previous models, the mother's educational level ($\beta = 0.11$, $p = 0.012$) and children's age ($\beta = 0.04$, $p < 0.01$) were also significantly related to vocabulary, although these relationships were less strong.

Table 2.3

Multilevel model of vocabulary prediction. Estimates, Standard Errors and Beta values (N = 223) are shown for each model

	Model 0		**Model 1**			**Model 2**			**Model 3**		
Fixed model	*Estimate*	*SE*	*Estimate*	*SE*	*β*	*Estimate*	*SE*	*β*	*Estimate*	*SE*	*β*
Intercept	26.38**	1.60	19.70**	1.50	-0.44	21.19**	1.39	-0.35	21.99**	1.45	-0.29
Predictors											
Child age			1.30**	0.24	0.08	0.76**	0.24	0.05	0.67**	0.23	0.04
Child gender[1]			1.86	1.70	0.12	1.07	1.57	0.07	0.04	1.55	0.00
Family context											
Linguistic diversity[2]			12.84**	1.85	0.82	10.42**	1.74	0.66	9.82**	1.72	0.62
Education mother			1.62*	0.74	0.10	1.53*	0.68	0.10	1.67*	0.66	0.11
Reading activities at home			4.73	2.94	0.30	2.51	2.73	0.16	2.29	2.64	0.15
Parent self-efficacy			5.84	3.30	0.37	4.53	3.04	0.29	2.64	3.00	0.17
Executive functioning						14.10**	2.21	0.90	10.58**	2.34	0.67
Social functioning									7.47**	2.04	0.48
Random model	*Variance (SE)*		*Variance (SE)*			*Variance (SE)*			*Variance (SE)*		
Preschool level	19.19 (13.00)		3.60 (4.87)			2.81 (4.01)			5.96 (5.11)		
Individual level	227.38 (22.18)**		149.09 (14.53)**			126.30 (12.31)**			117.30 (11.44)**		
Total	246.57		152.69			129.11			123.25		
R^2	-		.38			.48			.50		
Δ-2 log likelihood	1854.38		1753.31			1715.09			1703.38		
χ^2 difference test			$\chi^2(6) = 101.07$**			$\chi^2(1) = 38.22$**			$\chi^2(1) = 11.709$**		

$R^2 = (\sigma_{\text{null model}} - \sigma_{\text{estimated model}}) / \sigma_{\text{null model}}$ * $p < .05$ [1] reference category = girl, ** $p < .01$ [2] reference category = L1

Discussion

In this study we investigated the role of EF and SF in predicting preschool children's vocabulary over and above the family context. The results support the theory that the impact of parent-child interaction on children's vocabulary depends on child functioning in addition to the family context (Bronfenbrenner & Morris, 1998). Our findings confirm previous studies (Ebert et al., 2013; Hoff, 2006; Van Druten-Frietman et al., 2015) showing the large impact of the family context. Linguistic diversity and mother's education were found to be strong predictors of children's vocabulary. Secondly, our findings complement and extend previous research as it shows that, a child's EF and SF predict vocabulary over and above family contextual factors. These results show that, when examining associations between EF, SF and early vocabulary, it is important to integrate the child's functioning and the family context.

With regard to the family context, this study confirms previous research showing that linguistic diversity and education of the mother are significant predictors of children's vocabulary (Ebert et al., 2013; Van Druten-Frietman et al., 2015). Linguistic diversity (being a first (L1) or second language learner (L2) of Dutch) was found to have an especially strong impact on vocabulary. The impact of linguistic diversity and educational level on vocabulary can be explained by the amount and quality of language input children are exposed to at home. L2 children often experience less input in the native language of the country that they are growing up in at home because a certain amount of the language input they receive is in another language (Scheele et al., 2010; Van Druten- Frietman et al., 2015). The mother's educational level also has an impact on the quantity and quality of language input, with lower educated mothers often engaging in fewer reading activities with their children and, in general, using less abstract and challenging language (Van Kleeck et al., 1997). This is reflected in children having smaller vocabularies (Hoff, 2006). The current study confirmed the impact of the mother's educational level on vocabulary.

Furthermore, we hypothesized that the educational level of the mother would be reflected in the frequency of reading activities conducted at home and parents' degree of self-efficacy and that reading activities and parent self-efficacy would therefore contribute to vocabulary. Contrary to previous studies (Ebert et al., 2013; Walker et al., 2005) and to our expectations, the frequency of reading activities and parent self-efficacy did not contribute to children's vocabulary in the current study. We therefore need to consider the appropriateness of the measures identifying reading activities and parent self-efficacy. With regard to reading activities, we measured the frequency of

reading activities taking place at home (for example the frequency of shared book reading) rather than the quality of these reading activities (for example whether parents asked their child questions during book reading). Because vocabulary is influenced by both the quantity and the quality of reading activities, this might explain why the reading questionnaire did not predict vocabulary in this study.

The parent self-efficacy measure used in the current study consisted of general self-efficacy statements (such as 'I can motivate my child') that did not directly relate to parent's self-efficacy in the realm of parent-child interaction or vocabulary stimulation. We recognize that the parental self-efficacy questionnaire used in the current study may have been too general to establish a relationship with children's vocabulary. Finally, there are two methodological issues that may explain the unexpected findings. It is possible that the help provided to parents with lower language skills resulted in socially desirable outcomes. Also, the modest reliability of both measures shows that items on the questionnaires did not measure a coherent construct. Reading activities and parents' self-efficacy in literacy activities with their children are presumably important for children's vocabulary, but we were not able to demonstrate this relationship in our study. Despite this, the family context explained 30% of the variance, confirming that the family context plays an important role in children's vocabulary.

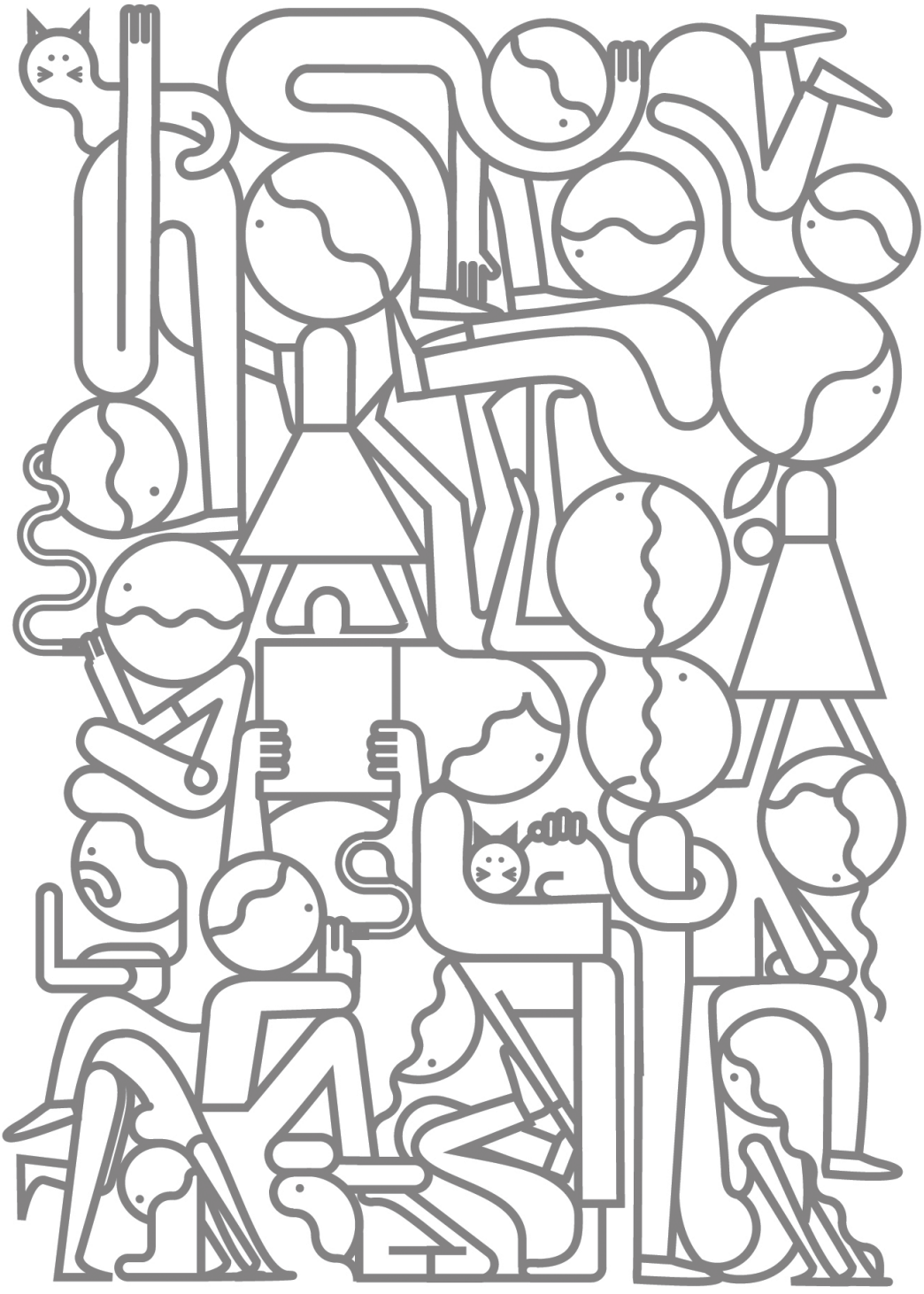
This study is among the first to demonstrate that, in addition to the family context and children's age, EF and SF of children predict their preschool vocabulary. EF proved to be a significant and very robust predictor of vocabulary. This finding shows that children who are able to control and regulate their social and cognitive behavior have larger vocabularies. It indicates that EF helps children to control social interactions in such a way that they obtain the linguistic input that they are in need of. This strongly suggests that being able to make adaptive changes in social environments, in order to execute appropriate social interactions, and to inhibit inappropriate interactions enhances children's vocabulary. With regard to the ability to control cognitive behavior, EF supports processing of multiple streams of language input at the same time and storing this information. Whereas recent research has shown the contribution of EF to children's communicative behavior and vocabulary (Moriguchi, 2014; Weiland et al., 2014), this study highlights its robustness because it was examined in conjunction with firm family contextual factors.

Moreover, SF also contributes to vocabulary. This finding underlines the social dimension of vocabulary learning. Children who engage in more interactions seem to have larger vocabularies (McClelland et al., 2000; Vitiello & Williford, 2016). SF significantly and strongly contributed to children's vocabulary, even when including EF and family contextual factors. This emphasizes the strong and unique role of SF in preschool vocabulary. This finding suggests that the ability to sustain a social interaction is necessary to bring language into practice and to acquire vocabulary from linguistic input. In general, children with higher SF make contact more easily and are involved in more verbal interactions, resulting in larger vocabularies (Vitiello & Williford, 2016) and higher academic performances (McClelland et al., 2000). Understanding the reciprocal nature of social interactions allows children to enter into conversations and to sustain interactions.

There are some limitations to this study. First, vocabulary, the family context and the child's functioning were measured at the same time. Therefore, it is important to note that the relations are correlational and not causal. Second, all measures assessed in the child (vocabulary and EF tasks) were administered in Dutch. It was not possible to administer tests in the native language of the L2 children. The sample consisted of 48 different native languages and not all parents could speak Dutch which did not allow us to translate the task. The instructions and task were in Dutch, which might have resulted in L2 children scoring lower. The working memory task consisted of strings of common Dutch one-syllable words and this particular task might have been more difficult for the L2 children than for the L1 children because some words might have been unfamiliar to the L2 children. However, means and standard deviations did not show floor effects for L2 children indicating that they were familiar with the Dutch words. As Wiebe and colleagues (2011) stated, EF tasks should draw on basic concepts that children from all backgrounds might have mastered. Even though the multiple-task approach provided a robust measure of children's EF, future studies should consider less language-dependent EF tasks. In addition, we consider vocabulary to develop via interaction and therefore it would have been of great value to include a more direct measure of parent-child interaction (for example, observation of a shared book reading activity) in the study design.

To conclude, this study shows that cognitive and social abilities both play an important role in the vocabulary of preschool children, even when taking into account firm family contextual factors. The impact of linguistic diversity and education of the mother emphasizes that EF and SF need to be investigated in conjunction with the family context. As both a child's functioning and the

family context are very meaningful at this age, educational policy should focus on stimulating a child's functioning within the home environment by, for example, home literacy programs (Van Steensel, McElvany, Kurvers, & Herppich, 2011). This is especially of importance in the Netherlands where children receive very limited hours of preschool per week and much therefore depends on the home situation. The current study suggests, that the curriculum of these home literacy programs would be more effective when activities are included stimulating cognitive and social abilities of children as both dimensions were proved to be significant predictors of preschool vocabulary.



Chapter 3

Technology-enhanced storytelling stimulating parent–child interaction and preschool children's vocabulary

Based on

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Abstract

Preschool children's vocabulary mainly develops through verbalinteraction. Therefore, the technology-enhanced storytelling (TES) activity Jeffy's Journey is developed to support parent–child interaction and vocabulary in preschool children. TES entails shared verbal storytelling supported by a story structure and real-time visual, auditory and textual prompts on a tablet computer. In this exploratory study, we investigated how TES influenced parent–child interaction and vocabulary. An experimental pretest-intervention-posttest design was followed with 44 3-year-old children and their parents in the experimental group and 27 peers in the control group. Results revealed that TES fostered active child involvement and generated parent–child interaction, yet a great variety in TES characteristics both in time spent and usage of prompts was found among participants. Dyads that spent more time on story phases showed more and higher quality parent–child interaction. The usage of prompts was associated with improved parent–child interaction quality. Finally, an effect of TES was evidenced on children's productive vocabulary. To conclude, this study demonstrates that TES can be considered as a promising context for fostering parent–child interaction and children's vocabulary development.

Introduction

Vocabulary in preschool children is essential for expressing themselves and communicating with others. Before children enter formal schooling, their vocabulary develops mainly through verbal interaction with parents and other family members (Mol & Neuman, 2014; Vygotsky, 1978; Weizman & Snow, 2001). There is a wide variation in the quantity and quality of parent–child interaction which is, amongst other factors, related to sociolinguistic background. In lower socio-economic status (SES) and multilingual ethnic minority families, generally less parent–child interaction is taking place (Bradley & Corwyn, 2002), and the quality is lower as these parents leave less room for active and challenging child participation (Van Kleeck, Gillam, Hamilton, & McGrath, 1997). As a consequence, vocabularies of children growing up in these families are found to be smaller and develop at a slower rate (Hoff, 2006).

Teaching parents higher-quality interaction skills via traditional training methods used in family literacy programs (FLPs) is challenging (Van Steensel, McElvany, Kurvers, & Herppich, 2011). Therefore, we introduce technology-enhanced storytelling (TES) providing real-time support for parent–child interaction via a tablet computer. This approach was shown successful in a previous study where a digital elaboration image including textual and visual prompts fostered parent–child interaction and children's vocabulary (Gremmen, Molenaar, & Teepe, 2016). Elaborating on this, we developed the TES activity Jeffy's Journey. Jeffy's Journey supports shared verbal storytelling of parent and child with real-time support through a story structure and visual, auditory and textual prompts.

We investigated how parent and child engage in TES and how it influences parent–child interaction and children's vocabulary. An experimental pretest-intervention-posttest design was followed with 44 3-year-old children and their parents in the experimental group performing Jeffy's Journey and 27 peers in the control group. In the following literature overview, we first outline the importance of the quantity and quality of parent–child interaction for children's vocabulary. Subsequently, we elaborate on how technology can support parent–child interaction and consequently influences children's vocabulary.

Vocabulary development via parent–child interaction

A rich home language environment, in which parents and children are engaged in activities such as shared book reading, storytelling and game play, is important for children's vocabulary development (Dickinson & Tabors, 2001; Korat, Klein, & Segal-Drori, 2007; Mol & Neuman, 2014). Especially, the parent–child interaction

taking place during these activities enhances children's vocabulary (Van Kleeck et al., 1997; Vygotsky, 1978). The more time parents spent on activities with their child, the more interaction is taking place between them and the more opportunities the child experiences to learn new word meaning and to enlarge existing word knowledge (Hoff, 2006).

In addition to interaction quantity, active child participation is important as demonstrated within the dialogic reading context (Mol, Bus, De Jong, & Smeets, 2008; Zevenbergen & Whitehurst, 2003). Active child participation is especially beneficial for the development of productive vocabulary (Mol et al., 2008), as the child needs to use words in order to acquire productive vocabulary (Sénéchal, Thomas, & Monker, 1995). Parents can use evocative techniques to make their child an active story teller as opposed to a passive listener, for example, by asking open-ended questions to elicit verbal responses and providing feedback (Zevenbergen et al., 2003).

Parents can use and instigate different quality of interaction. They can talk about the here and now by labelling objects and describing characters that are perceptually present (Van Kleeck et al., 1997). This contextualized type of interaction can be extended by decontextualized language that is beyond perceptual presence. Decontextualized language includes for example summarizing story content or making predictions about what will happen in the story. The latter type of language is more challenging and demanding and hence considered to be more beneficial for vocabulary development (Hoff & Naigles, 2002; Van Kleeck et al., 1997).

In lower SES and ethnic minority families, generally, there are fewer materials such as picture books and games available at homes, resulting in less frequent parent–child activities and parent–child interaction (Neuman & Celano, 2001). Moreover, lower SES parents tend to have a more dominant role during interaction with less active child participation (Hoff, 2006). They are more likely to ask contextualized where-questions and what-questions compared to decontextualized why-questions and how-questions (Bus, Leseman, & Keultjes, 2000; Deckner, Adamson, & Bakeman, 2006). As a result, children growing up in these families have smaller vocabularies (Hoff, 2006; Hoff & Naigles, 2002).

These families need support to engage in parent–child interaction with increased active child participation and high-quality interaction. One way to provide this support is via FLPs that aim to enhance parent–child interaction via parent meetings during which interaction behavior is trained (Sénéchal & Young, 2008). A review of Van Steensel et al. (2011) on the effects of FLPs demonstrated only a small mean effect of FLPs on children's vocabulary. It was

assumed that high-quality interaction behavior may be difficult to teach and learn via traditional training methods used in FLPs, such as modeling and role play (Carpentieri, Fairfax-Cholmeley, Litster, et al., 2011; McElvany & Van Steensel, 2009; Van Steensel et al., 2011). Specifically, the transfer of this behaviour to activities in the home context is found to be challenging. Therefore, we propose to support parent–child interaction real time during TES.

Storytelling to support parent–child interaction

Storytelling provides an ideal context for active child participation and parent–child interaction and fosters children's vocabulary development (Mol et al., 2008; Whitehurst et al., 1988). Next to traditional picture books, wordless picture books enhance storytelling (Ramos & Ramos, 2011). Wordless picture books elicit active participation as parent and child create a story together (Bosh & Durán, 2009). They discuss the relationship between pictures and uncover the story line by encountering different characters and their problems (Dimino, Taylor, & Gersten, 1995). A wordless picture book includes connections between story components and provides background information to create a meaningful storyline (Peterson, 1994). When parent and child engage in storytelling supported by a wordless picture book, they are likely to engage in contextualized parent–child interaction defining the characters and settings. This context also generates decontextualized interaction as the pictures need to be interconnected to create a story.

However, creating a meaningful story requires extensive skills of the parent. The parent needs to ask questions, provide feedback and stimulate the child to actively participate in story creation (Vygotsky, 1978; Zevenbergen et al., 2003). As was reported earlier, these skills may not be evident in all parents. A way to help parents during storytelling is through real-time interaction support. Recent research demonstrates that specific design principles and prompts in technology-enhanced activities enhance parent–child interaction (Gremmen et al., 2016) and children's vocabulary (Takacs, Swart, & Bus, 2015). Within the storytelling context, Gremmen et al. (2016) conducted a study with a digital elaboration image that included visual and textual prompts (i.e. zoom elements and open-ended questions) for rich parent–child interaction and story construction. Results showed that the prompts enhanced decontextualized parent–child interaction and resulted in higher vocabulary gains compared with a paper condition without prompts.

Korat, Shamir, and Heibal (2013) concluded that parent–child interaction during e-book reading with visual prompts (dynamic visuals and hotspots),

auditory prompts (music effects) and textual prompts (highlighted written phrases) encouraged decontextualized language such as sharing personal experiences. In a similar vein, Fisch, Shulman, Akerman, and Levin (2002) showed that including visual prompts, such as choice points that ask users to direct the storyline, encouraged parents' and children's decontextualized language such as making predictions about the story. In contrast, a study of Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff and Collins (2013) showed that digital prompts can also distract from story content when they are not congruent with the storyline. Electronic console books with visual and auditory prompts (i.e. puzzles, games, songs and word repetitions) caused interruptions, mid-sentence pauses and other distractions that were detrimental to parent–child interaction quality.

Thus, there is evidence that visual, auditory and textual prompts can support interaction, as long as they are congruent with the story and do not distract from story content or hinder active participation. This was confirmed in a recent meta-analysis on effects of TES on children's vocabularies. Takacs et al. (2015) conclude that multimedia features like animated pictures, music and sound effects were beneficial for children's productive vocabulary and story comprehension, whereas interactive elements like hotspots, games and dictionaries were not.

Another design principle of TES is giving parents and children control of story content and story pace, to encourage active participation and high-quality parent–child interaction. Within the context of shared electronic book (e-book) reading, several studies showed the importance of parents and children being in control of the course of the story. When being in control of the story course, children were more actively participating in story construction (Fisch et al., 2002). In line with this, Kim and Anderson (2008) showed that giving parent and child control of pace the story resulted in more interaction compared with a closed format in which pages were turned automatically. Moreover, they showed that e-books with a voice-over served more as listening materials and involved fewer verbal interactions about the story. A voice over hinders active participation and story creation of parent and child. Therefore, we propose to provide a storytelling format in which parent and child tell the story themselves, and, following previous research, are in control of the story line and story pace, and are guided by prompts that are contingent with the storyline.

Elaborating on the discussed literature, we developed the TES activity Jeffy's Journey. In Jeffy's Journey, the format of shared wordless picture book is integrated because this has proven to stimulate active participation of the

parent and the child (Bosh & Durán, 2009; Ramos & Ramos, 2011). As creating a meaningful story requires extensive skills of the parent, technology was used to support the storytelling process. In the first place, Jeffy's Journey followed three design principles to support the creation of a meaningful story. First, Jeffy's Journey consisted of storytelling phases, to know, an introduction story, avatar selection and a story creation phase (further explained in the method section). In these phases, the structural elements of a meaningful story (a problem, characters and the relation between events) were outlined (Dimino et al., 1995). Providing the structure of the story was shown to be helpful for creating a meaningful and coherent story (Harris & Schroeder, 2012).

The second design principle was parents and children being in control of the storyline. They could create their own story following the pictures in the introduction story, and they could select the characters of the story in the story creation phase. Following Kim and Anderson (2008), there was no digital narrator or digital voice-over so that dyads could determine the course and pace of the story themselves. As a third principle, we included explicit turn regulation, that is to say, parent and child alternately determined the course of the story by selecting characters. This was included to enforce well balanced participation of parent and child, and also to prevent a conflict about who was in control of the screen. Turn taking during a technology-enhanced activity facilitates verbal interaction between preschool children (Therrien & Light, 2016), and we assumed the same would hold for parent–child dyads.

In addition to these principles, prompts were added with the purpose to enrich parent–child interaction around the storyline. Visual, auditory and textual prompts corresponding to the storyline were shown to enhance parent–child interaction (Gremmen et al., 2016; Korat et al., 2013). Therefore, prompts such as visual changes, word pronunciations and open-ended question were included to foster contextualized and decontextualized language. In line with the second control principle, prompts were not offered automatically, but parent and child were in control of their implementation. In sum, we assumed that providing a structured storytelling activity accompanied with visual, auditory and textual storytelling prompts would result in active and meaningful storytelling with high-quality parent–child interaction.

Present study

The aim of this study was to explore how parent and child interact during TES. Jeffy's Journey is designed following design principles that are derived from research into children's vocabulary development and parent–child interaction.

An experimental pretest-intervention-post-test design was followed with 44 3-year-old children and their parents in the experimental group and 27 peers in the control group. Parent–child dyads in the experimental condition did Jeffy's Journey twice. We examined TES characteristics, namely, the time spent on different storytelling phases and the use of prompts. Additionally, we analysed the quantity and quality of parent–child interaction. To establish how the design of Jeffy's Journey influenced parent–child interaction, we looked at their relation with TES characteristics. Finally, we investigated the effects of TES on children's receptive and productive vocabulary. Planning to analyse these particular aspects, the following research questions guided our study:

1. How do parent and child engage in TES?
2. Do the design principles influence active child participation and the quantity and quality of parent–child interaction?
3. What are the effects of TES on children's vocabulary?

Based on previous research, we expected the design principles of TES to stimulate active child participation and the quantity and quality of parent–child interaction (for example Gremmen et al., 2016; Korat et al., 2013). Furthermore, we expected that storytelling with Jeffy's Journey would facilitate both children's receptive and productive vocabulary. This hypothesis is based on studies that demonstrated the importance of contextualized and decontextualized parent–child interaction for children's receptive and productive vocabulary development (Sénéchal, 1997; Van Kleeck et al., 1997).

Method

Participants and design

Four Dutch preschools in multi-ethnic neighborhoods in middle sized urban areas were approached to participate and all agreed on participation. All parents and children of a preschool were invited to participate. A total of 61 experimental parent–child dyads and 27 control children started the study. Four dyads were excluded because the child was absent during post-test session. Thirteen dyads were excluded because the Dutch language level of parent and/or child appeared insufficient for task understanding and execution. This resulted in an experimental group of 44 parent–child dyads and 27 controls. The experimental group consisted of ten fathers and 34 mothers and their child (25 girls and 19 boys) aged 27 to 46 months ($M = 39.41$, $SD = 4.82$). Educational level of the parents ranged from no education (2.3%), primary school level (4.5%), high school level (11.4%), vocational education (47.7%), higher professional education (18.2%) to university education (13.6%).

The control group consisted 27 children (17 girls and ten boys) aged 31 to 47 months (M = 41.11, SD = 4.46). Educational level of the parents ranged from no education (7.5%), primary school level (13%), high school level (33.3%), vocational education (37%), higher professional education (5.6%) to university education (1.9%).

A pretest-intervention-posttest control group design was followed with experimental parent–child dyads doing Jeffy's Journey twice within a period of 2 weeks. The receptive and productive vocabulary pre-test and post-test were administered in experimental and control children (N = 71) at the beginning and end of the 2 weeks. Control children did not receive the intervention. All parents gave active consent for their own and their child's participation.

Technology-enhanced storytelling with Jeffy's Journey

Jeffy's Journey is a TES activity carried out on a tablet computer. In the first phase (introduction story), six wordless images demonstrate the elements of the storyline: the main character, problem and setting of the story (Figure 3.1, phase 1). In Jeffy's Journey, Jeffy is the main character whose suitcase is stolen by a bird while he is waiting at the bus stop on his way to grandma. The bird flies away with the suitcase and drops it over the zoo. The last image of the introduction story defines the problem: it shows a desperate Jeffy, thinking about how to get his clothes back before he can go to his grandmother. By showing one image at a time, we intended parents and children first to label, notice and describe characteristics of characters, objects and the setting (contextualized language). Secondly, for story construction, they need to connect the six images by inferencing, summarizing, predicting, comparing, reasoning and defining the problem (decontextualized language).

In the second phase (avatar selection), parent and child both selected an avatar that was a graphical representation of themselves (Figure 3.1, phase 2). Avatars indicated a storytelling turn of the parent or the child. Avatars were included to stimulate turn regulated storytelling with well-balanced participation of parent and child. Moreover, turn regulation would prevent a conflict between parent and child on who was in control of the tablet screen. Activation of avatars was technology driven.

In the third phase (story creation), parent and child continued the story of the introduction. In this phase, the main character Jeffy comes alive (Figure 3.1, phase 3). Supported by visual, auditory and textual prompts, parent and child create Jeffy's story. Jeffy is in the zoo to retrieve his clothes from the animals. Parent and child navigate through the zoo by picking up Jeffy and moving him to visit an animal. When Jeffy visits an animal, an aspect of the animal changes

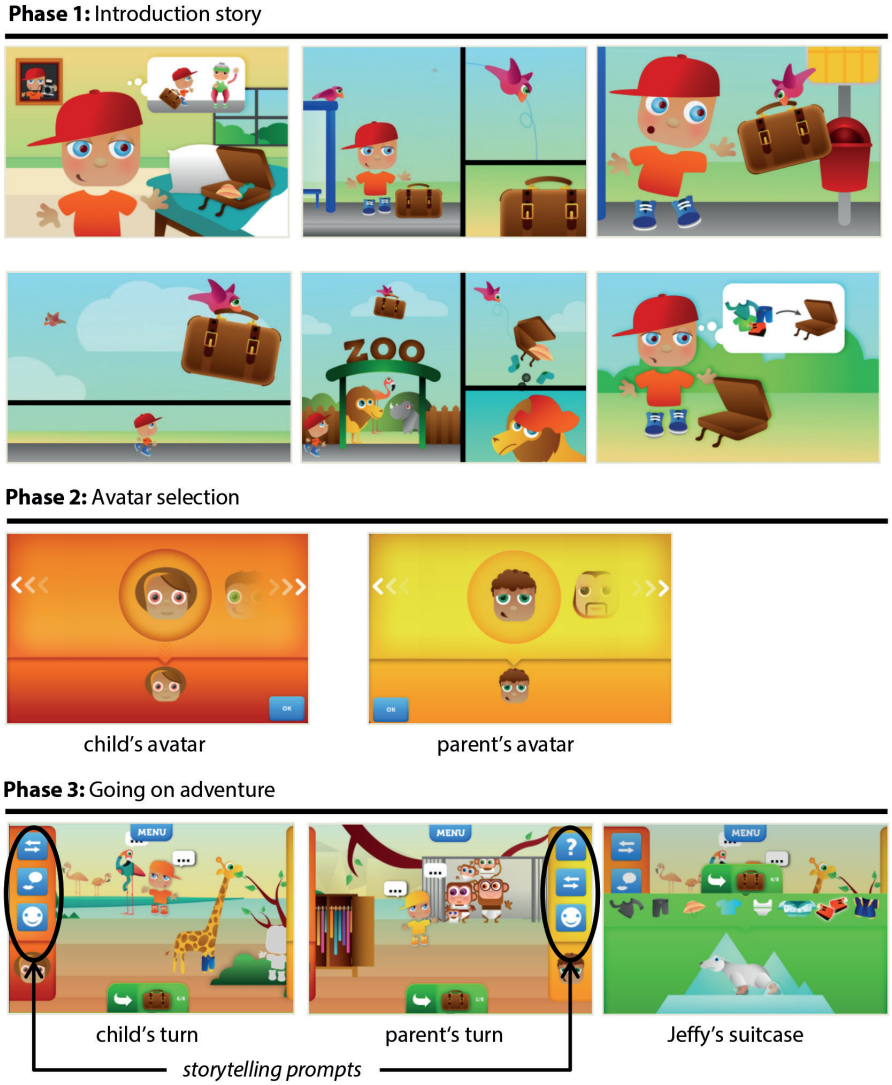
(position, action and color). For example, the monkeys turn upside down. With this visual prompt, we intended parent and child to notice, label and describe the characters taking part in the story.

At each animal, parent or child (depending on who's turn it was) could select visual, auditory and textual storytelling prompts. The emotion, word, swop and question prompts were expected to instigate elaborate character descriptions and more in-depth storytelling. Firstly, the emotion prompt caused the change of a character's emotion to happy, sad or angry. This visual prompt was expected to enhance decontextualized parent–child interaction about the point of view and feelings of a character. Secondly, the word prompt pronounced a word. This auditory prompt provided phonological input and was used to instigate contextualized parent–child interaction about the label, location and meaning of a word. The swop prompt made a character do something funny. This visual prompt could encourage contextualized language about the character's characteristics and actions and decontextualized language about why the character was acting in that way. In the parent's turns, the word prompt was replaced by a question prompt. With this textual prompt, a story-related question popped up, for example, 'Which animals did we visit so far?'. Contextualized questions were about colors, shapes, counting or sounds of a character, whereas decontextualized questions asked for making a prediction or summary of the story, or connecting the storyline to personal experiences. All prompts could be used unlimitedly. Going from one animal to another, parent and child created the story of Jeffy retrieving his clothes, with elaborate descriptions of the animals that took his clothes.

The retrieved clothes were stored in Jeffy's suitcase that could be viewed at all times (Figure 3.1, Jeffy's suitcase). It showed which items were collected at which animal and which items were still missing. The suitcase was provided to repeat story elements and to elicit decontextualized interaction as summarizing (what did Jeffy already find) and predicting (where does Jeffy still needs to go). When all eight garments were collected, an overview of the suitcase was provided in order to summarize, look back and conclude the story.

Figure 3.1

Technology-enhanced storytelling with Jeffy's Journey



Measures

Technology-enhanced storytelling characteristics

Technology-enhanced storytelling characteristics were derived from log files in which all technical aspects of storytelling were tracked. Each performance, for example, the moment parent and child started and finished the introduction,

was displayed with a time stamp; and from this time spent on storytelling phases was derived. Use of storytelling prompts was also derived from the log files, as the system tracked which storytelling prompts were used and how often. These characteristics were used to investigate associations between technology use and the quantity and quality of parent–child interaction.

Parent–child interaction

Parent–child interaction was transcribed from the videotaped TES sessions. All utterances were coded following the Van Kleeck et al. (1997) adapted version of the four levels of abstraction coding scheme, which we also used in the study of Gremmen et al. (2016). Following Van Kleeck et al. (1997), we distinguished story-related utterances, procedural-related utterances and interaction-related utterances. Unintelligible utterances and non-responses were not coded (see Appendix B for the complete scheme and examples). Story-related utterances were comments and questions about the storyline.

Story-related utterances were further coded on their quality by the four levels of abstraction. These levels describe to which extent an utterance refers to contextualized information that is perceptually present or to decontextualized information that is beyond perception. The first two abstraction levels included contextualized utterances, whereas the third and fourth level contained decontextualized utterances. Procedural-related utterances included utterances on functional aspects of TES and the tablet. Interaction-related utterances involved utterances that parents and children used to support each other, give feedback or engage to complete the task.

For each dyad, interaction of two TES sessions was transcribed and coded. Due to technical issues, sound quality of some videos was of insufficient quality for being transcribed and coded. Only dyads of which both videos were suitable were coded. In total of 27 dyads, both videos were suitable, resulting in 54-coded transcripts. Coding was carried out by the first author and two trained research assistants. All videos were transcribed, and subsequently, each utterance received a single code. The first two transcripts were coded and discussed by all coders. Subsequently, four transcripts were double coded, in order to determine inter-rater reliability. Inter-rater reliability (Fleiss' K) on the main categories (i.e. interaction, procedural and story-related utterances) was $K = .77$ and on the sub-categories of story-related utterances $K = .77$, which was sufficient to continue coding (Fleiss, 1981).

Vocabulary

We designed a task-specific vocabulary test consisting of 30 words. Referents of all 30 words were perceptually present in TES, and attention was drawn to the target words by the prompts. All 30 vocabulary items were assessed both productively and receptively, following the age appropriate testing format of the Peabody Picture Vocabulary Tests (Schlichting, 2005). In the productive vocabulary task, children were shown a picture of the target word, and simultaneously, they were asked to complete a sentence in which the target word was left out (for example: "When you go to sleep, you wear your ... [pajama's]?"). For each correctly completed sentence, one point was assigned with a maximum of 30 points. All other responds than the target word were assigned a zero score. Internal consistency of this task was sufficient (Cronbach's $\alpha = .89$). In the receptive task, children had to select the picture of the target word out of three distracters (perceptual, phonological and semantical). Each correctly selected item was assigned one point, resulting in a maximum score of 30 points. Internal consistency of the receptive task was sufficient (Cronbach's $\alpha = .85$).

Procedure

Parents were recruited and informed about the study via an information brochure. Firstly, productive and receptive vocabulary (the former first) tests were administered in all 71 children. Next, the 44 experimental dyads did TES with Jeffy's Journey on a tablet computer, twice in separate intervention sessions. Subsequently, all 71 children were post-tested on productive and receptive vocabulary. In addition, parents filled out a background questionnaire. The entire study took place within a period of 2 weeks.

Intervention and test sessions were conducted by the first author and trained research assistants. Test administrators first spent time with the children in the preschool so that children could become familiar with them. Children were tested individually in a quiet room in their preschool. Test sessions took approximately 10 min per child. At the beginning of the intervention sessions, parents received verbal instruction on TES. The test administrator clarified an instruction sheet explaining the goal of the activity. The parent was allowed to keep the instruction sheet during the activity and was informed not to ask for help during storytelling. Intervention sessions were video-recorded and took approximately 10 min per session ($M = 9.57$, $SD = 2.20$).

Data analyses

In order to answer our first research question, we calculated means and standard deviations for the TES characteristics time spent on different storytelling phases and use of storytelling prompts. Also, means and standard deviations of the quantity and quality of parent–child interaction were calculated. Calculations were carried out on data of the two intervention sessions together. For answering our second research question, we explored Pearson's correlation matrixes, in which we associated the TES characteristics with parent–child interaction quantity and quality. For the final question, we ran separate Multiple Regression Analyses on receptive and productive vocabulary tests, with post-test scores as dependent variables and pre-test scores and condition (0 = control, 1 = experimental) as independent variables. Testing was carried out at $p < .05$.

Results

Technology-enhanced storytelling characteristics and parent–child interaction

Descriptive statistics of TES characteristics and the quantity and quality of parent–child interaction are presented in Table 3.1. Over two sessions of TES, dyads spent on average four and a half minutes on the introduction story in which they discussed the characters, setting and problem of the story. They spent half a minute on the second phase in which they selected their avatar for turn regulation. With over 15 minutes, parents and children spent most time on the story creation phase. In this phase, which was the core of the activity, they created the story and tried to solve the problem that was introduced in the introduction story. Large standard deviations indicate that there was a great variety in the time parent–child dyads spent on each phase.

During the story creation phase (third phase), dyads had access to storytelling prompts: an emotion, swop, word and question prompt. Half of the group used the storytelling prompts ($n = 22$). The emotion prompt was, with an average of 9.64 times, applied most often and used by 81.8% of the dyads. The question prompt was used least (1.68 times on average) and used by 50% of the dyads. The swop and word prompt were used to the same extent (5.09 and 4.41 times on average) and used by 72.7% and 63.6% of the dyads, respectively. Overall use of storytelling prompts differed highly across parent–child dyads. The storytelling prompts were not used at all by 9.1% of the dyads.

Table 3.1

Technology-enhanced storytelling characteristics and the quantity and quality of parent-child interaction

	Mean	SD	Min.	Max.
Time spent on storytelling phases[1]				
Phase 1: Introduction story	04:28	02:11	00:24	09:36
Phase 2: Avatar selection	00:38	00:26	00:10	02:09
Phase 3: Story creation	15:10	03:31	08:41	26:15
Use of storytelling prompts[2]				
Emotion prompt	9.64	10.34	0	43
Swop prompt	5.09	6.85	0	26
Word prompt	4.41	5.72	0	19
Question prompt	1.68	2.58	0	12
Child utterances[3]				
Interaction-related	12.15	10.58	0	34
Procedural-related	37.07	25.92	3	118
Story-related	57.93	47.23	7	251
Contextualized	47.89	35.21	7	176
Decontextualized	10.04	14.74	0	75
Total utterances	127.07	70.70	22	366
Parent utterances[3]				
Interaction-related	29.15	23.43	3	91
Procedural-related	121.00	56.23	24	214
Story-related	134.30	81.16	11	394
Contextualized	108.67	57.43	11	256
Decontextualized	25.63	29.47	0	138
Total utterances	298.19	137.18	56	679

[1] $n = 44$, [2] $n = 22$, [3] $n = 27$

Next, we explored parent–child interaction during the two TES sessions. Table 3.1 presents interaction quantity indicating the type of utterances parents and children made (interaction-related, procedural-related and story-related) and the quality of the story-related utterances (contextualized versus decontextualized). The table demonstrates that children were actively participating during TES. They made a substantial contribution to the interaction, with 127.07 mean utterances being 30% of the total conversation utterances. Most utterances were story related. The relative amount of story-

related contributions of parents and children was similar for both parent and child, with 45% of their total utterances. Parents talked relatively more about the procedure (40%), whereas children showed a smaller percentage of procedural talk (29% of their contributions). The interaction-related utterances were 9.8% of parental talk and 9.6% of children's talk. This indicates that parents guided the procedural aspects of TES but that story creation was carried out conjointly. When looking at the interaction quality, conversations were characterized by contextualized language with about 80% of the story-related utterances. There was also decontextualized language with around 20%. A wide range on all types of utterances shows that there were large differences among dyads in the quantity and quality of interaction during TES.

The influence of design principles on parent–child interaction

In order to understand how TES influenced parent–child interaction, we investigated the associations between TES characteristics and parent–child interaction, see Table 3.2. In the introduction story (phase 1), wordless pictures were used to generate interaction about the character, setting and problem. This phase was positively associated with the overall interaction quantity of both parents and children, indicating that there were many utterances in this phase. Moreover, the introduction story related to interactional-related and story-related utterances of children. For parents, this phase was positively related to all type of utterances, yet the strongest to story-related utterances. This indicates that during the introduction story parents and children together created the storyline and that parents guided the procedural aspects TES and their collaboration. Positive relations were found between the introduction story and contextualized and decontextualized language use of the parent. In this phase, the parent used contextualized language with character descriptions such as 'This is Jeffy and he is at the bus stop' and decontextualized language with reasoning like 'When you are at the bus stop, you have to wait for the bus'.

The second game phase (avatar selection) was a procedural phase in which turn regulation was introduced. Time spent on this phase positively related to procedural utterances of parents and children with discussions about choosing an avatar. For example, the parent said: 'You can click here to select the boy', to which the child replied: 'Ok, I click here'. The third game phase (story creation) was the most important phase during which parent and child created the actual story with the main character Jeffy. They were supported by storytelling prompts. Time spent on this phase was related to the overall interaction quantity of parents and children. This indicates that the story creation phase

stimulated interaction between parents and children. Moreover, this phase was strongly associated with story related utterances of the child and parent, and also with the parent's procedural-related utterances. This indicates that parent and child together created the story. In this story creation process, the child was equally active as the parent, whereas the parent provided additional procedural guidance. With regard to interaction quality, this phase strongly related to both contextualized language and decontextualized language of parents and children, with stronger relations to decontextualized language use. Using decontextualized language, the parent asked the child for example: 'Should we take this jacket for Jeffy?', to which the child replied: 'Yes, take it off'. Subsequently, the parent started reasoning: 'When it is getting colder, he will have to wear it. Otherwise he will feel cold'.

During this third phase, storytelling prompts aimed at generating contextualized and decontextualized parent–child interaction were available. The emotion and question prompt were positively associated with the parent's and child's story-related utterances and also with the parents' interaction-related utterances. Moreover, these prompts were positively associated with both contextualized and decontextualized language use, with a stronger relation to decontextualized language. For example, the emotion prompt resulted in decontextualized language making identifications with the character, like: 'We do not want him to be sad, right? And also not to be angry'. In another example, the question prompt led to interaction with the parent asking a summarizing question like: 'Which animals did we already visit?', to which the child replied: 'The owl with the feathers'. Thus, the emotion and question prompt indeed supported high-quality interaction when used.

The swop and word prompts showed weaker relations with parent–child interaction and were not associated with story-related interaction. The swop prompt was only related to interaction-related utterances of the child. A surprised reaction with the only verbal expression of 'Ohh!!' or 'Ahh!' was characteristic interaction for the functioning of this prompt. Finally, the word prompt was related to decontextualized language of both parents and children. For example, the parent's reaction on the word prompt was 'Jacket, you also have a blue jacket'. This above indicates that there are clear relations between the design principles and parent–child interaction that is generated during TES.

Table 3.2

Associations between technology-enhanced storytelling characteristics and the quantity and quality of parent-child interaction

	Time spent on storytelling phases (n = 27)			Use of storytelling prompts (n = 13)			
	Phase 1: Introduction story	Phase 2: Avatar selection	Phase 3: Story creation	Emotion prompt	Question prompt	Swop prompt	Word prompt
Child							
Interaction-related	.53**	.22	.22	.44	.59*	.59*	.38
Procedural-related	.23	.53**	.21	.17	.26	.04	.07
Story-related	.40*	.05	.57**	.80**	.85**	.22	.55
Contextualized	.37	.00	.51**	.78**	.83**	.22	.52
Decontextualized	.39	.16	.61**	.81**	.86**	.20	.61*
Total utterances	.51*	.31	.53**	.65*	.77**	.19	.46
Parent							
Interaction-related	.54**	.08	.33	.60*	.66*	.23	.53
Procedural-related	.48*	.51**	.49**	.47	.51	.32	.34
Story-related	.55**	.15	.56**	.76**	.80**	.38	.53
Contextualized	.53**	.11	.47*	.70**	.73**	.42	.45
Decontextualized	.47*	.20	.62**	.81**	.86**	.28	.62*
Total utterances	.59**	.28	.56**	.70**	.75**	.35	.52

* $p < .05$, ** $p < .001$

Effects of technology-enhanced storytelling on children's vocabulary

The last question investigated the effect of TES on children's vocabulary. Children's receptive and productive vocabulary scores are presented in Table 3.3. Multiple Linear Regression Analysis on receptive vocabulary (0 = control, 1 = experimental) demonstrated that the pre-test score significantly explained the post-test score (R^2 = .710, β = .83, $t(68)$ = 12.21, p < .001) and that there was no added value of condition (ΔR^2 = .002, β = .05, $t(68)$ = .67, p = .507). This indicates that the experimental group and control group made similar growth on receptive vocabulary and that there was no significant effect of TES. The analysis on productive vocabulary demonstrated that the pretest score again significantly explained the post-test score (R^2 = .809, β = .89, $t(68)$ = 17.19, p < .001) and that there was a significantly added value of condition (ΔR^2 = .012, β = .11, $t(68)$ = 2.09, p = .041). This indicates that there was a significant effect of TES on productive vocabulary showing that the experimental group learned more words compared with the control group.

Table 3.3

Descriptive statistics on pre-test and post-test scores of experimental (*n* = 44) and control (*n* = 27) children's receptive and productive vocabulary

	Receptive Vocabulary				Productive Vocabulary			
	Pre-test		Post-test		Pre-test		Post-test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Experimental group	21.32	4.76	22.11	4.84	12.93	5.87	15.59	6.15
Control group	18.11	6.02	18.59	7.25	11.70	5.80	13.07	6.01

Discussion

The purpose of this explorative study was to investigate how the TES activity Jeffy's Journey influenced parent–child interaction and vocabulary of preschool children. An effect of TES was evidenced on children's productive vocabulary. We explain this effect by elaborating on the design principles of TES and how they influenced parent–child interaction during the activity.

Technology-enhanced storytelling significantly improved children's productive vocabulary. This result is partially in line with our hypothesis and theory on vocabulary learning. The effect confirms that productive vocabulary acquisition takes place when children are encouraged to retrieve words in interaction with a parent (Hoff, 2006; Sénéchal, 1997). The fact that TES did

not affect receptive vocabulary could be explained by the incremental view of learning (Nagy & Scott, 2000). Vocabulary exists on a continuum where receptive vocabulary can be seen as a precursor for productive vocabulary (Stahl & Stahl, 2004). Receptive vocabulary test scores demonstrate that around one third of the words were already receptively known at pre-test. TES has contributed to a more complete understanding of the already receptively known word meanings. This might explain the gain found on productive knowledge, but not on receptive knowledge.

The effect on productive vocabulary can be clarified further by the design principles of TES and their influence on active participation and the quantity and quality of parent–child interaction. The combination of the design principles (structured storytelling via different phases, turn regulation, control of the storyline and the visual, auditory and textual prompts) stimulated active participation of both parent and child. Firstly, the three storytelling phases (introduction story, avatar selection and story creation phase) each had their specific contribution to parent–child interaction. During the introduction story, dyads use story-related utterances to define the characters, settings and the problem of the story. In this first phase, parent and child also used interaction-related language to enhance their collaboration, which appears important at the beginning of a collaborative activity. Selecting an avatar was expected to be a procedural aspect of the activity on which least time was spent. Indeed, this phase lasted on average half a minute and only resulted in procedural-related talk. Dyads spent most time on story creation, which was the most important phase. During this phase, parent and child together constructed the story using story-related language with the parent guiding the procedural aspect. Moreover, this phase generated high-interaction quality with both contextualized and decontextualized language. This analysis of story phases indicates that each storytelling phase has its specific relation to parent–child interaction. Moreover, it shows that parent–child interaction can be directed by the design of a storytelling phase. Thus, providing the structure of the story by different storytelling phases was helpful for generating active child participation and creating a meaningful and coherent story. This result is in line with previous research showing that a story structure is helpful for story creation (Harris & Schroeder, 2012).

The second principle of parents and children being in control of the storyline and story pace was included to stimulate active participation. During TES, parents and children were both actively participating with children being responsible for on average 30% of the total utterances and parents for 70%.

Moreover, almost half of their interaction was about the storyline. This confirms findings of previous research showing that control of the course of story events and the story pace, and the absence of a voice-over generates active story construction (Fisch et al., 2002; Kim & Anderson, 2008). The third principle, explicit turn regulation in which parent and child alternately determined the course of the story, stimulated well-balanced story creation. Parent and child equally participated in story creation, both with 45% of their contributions being story-related language. This study adds to the existing knowledge that turn regulation facilitates verbal interaction between preschool children (Therrien & Light, 2016) by showing that turn regulation also stimulates well-balanced participation of parent and child.

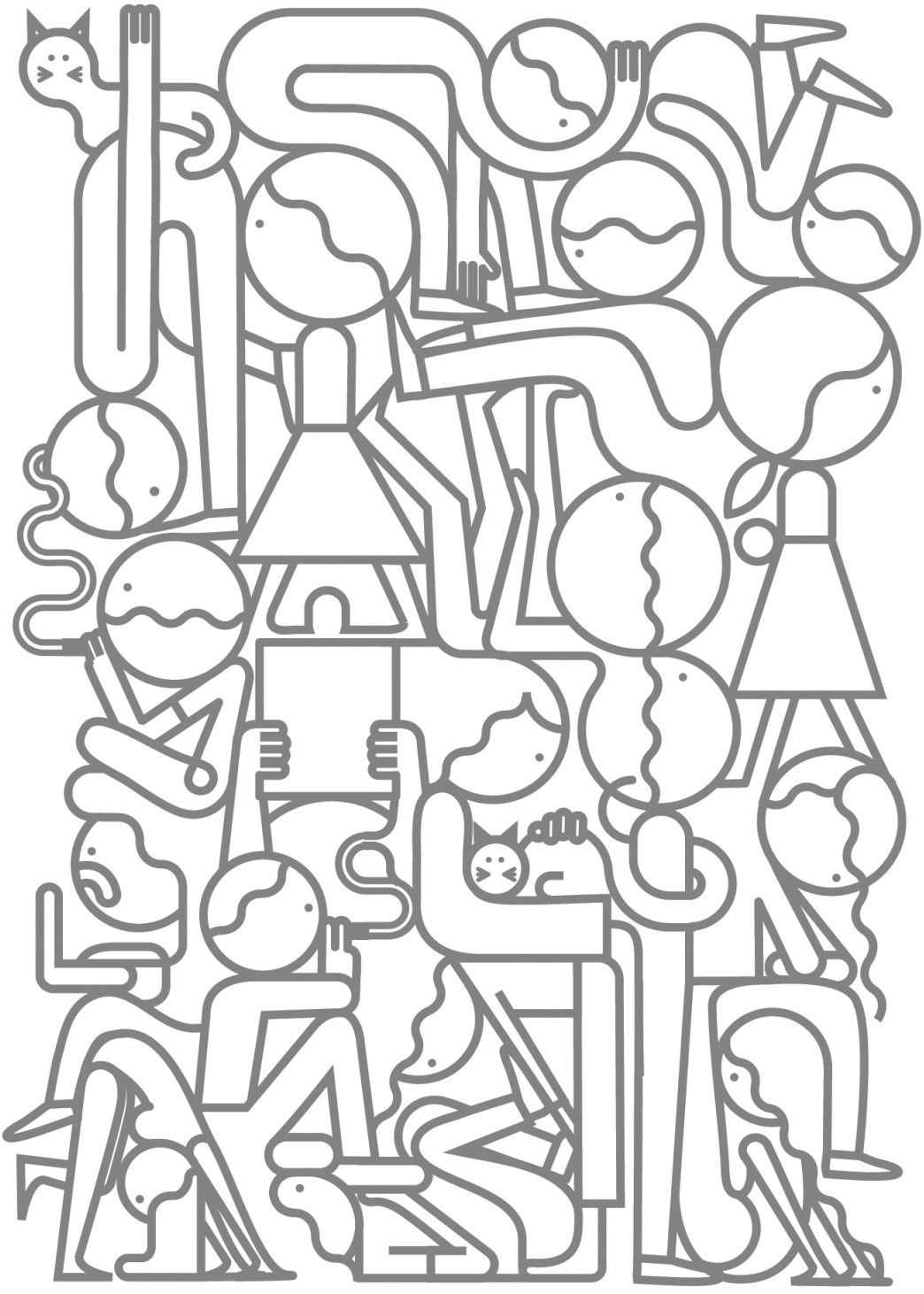
Next to three design principles that facilitated active participation during story creation, storytelling prompts were included to support interaction quality and rich interaction around the storyline. We found that the use of visual and textual storytelling prompts related to the quality of parent–child interaction. The emotion and question prompt generated contextualized and decontextualized language. The emotion prompt resulted in discussions about the character's feelings in relation to the story. The textual question prompt provided a question about the storyline. Even though this prompt was used limitedly, when it was used, it generated high quality story-related interaction. Surprisingly, the auditory word prompt did not generate story-related interaction. It might be that providing a single word does not result in the expected labelling behavior as single words might be too isolated for this storytelling context. This prompt could be improved by providing a word incorporated within a sentence, so that it becomes more integrated in the story (Takacs et al., 2015). The swop prompt was also not related to story-related language, yet it elicited interaction-related language of the child. It might be that this prompt, which made a character do something funny, was too complex to connect to the storyline. In line with findings of Gremmen et al. (2016) and Korat et al. (2013), the current study confirmed that prompts aligned with the story encouraged active verbal participation and facilitated high-quality story-related language. Prompts that were more difficult to connect to the storyline did not result in story-related language (Takacs et al., 2015). This in-depth evaluation of parent–child interaction during storytelling phases adds to the existing knowledge on how technology can support parent–child interaction.

Exploring the parent–child interaction during TES also showed a great variety among dyads. This variety was found both on the time spent on storytelling phases, the use of storytelling prompts and the quantity and quality of parent–

child interaction. This suggests that the TES context fosters different behavior. This finding is in line with the variety found on the time spent on EC book reading (Parish-Morris et al., 2013) where a wide range on reading time was revealed (5.27 to 30.37 min). Possibly, this variation relates to sociolinguistic background of parents and children, such as educational level of the parent or language level of the parent and child, or to experience with digital activities in general. However, as the design of this study did not allow us to explore what underlies this variation, these explanations are highly speculative and should be investigated in depth in a follow-up study.

This study has some limitations. A first limitation is that we included a no-treatment control group, resulting in a weak comparison group. Future research should therefore consider comparing variations of the TES context or relating this context to, for example, the context of shared e-book reading or a non-digital storytelling context. Also, in this study, we did not address differences between the first and second time of TES. Further research should be conducted to examine the development of storytelling characteristics and parent–child interaction over time. In addition, it is advisable to include a training phase to provide dyads with the opportunity to get acquainted with the TES context. As it was our goal to investigate how the TES context influences parent–child interaction and children's vocabulary, future research could investigate whether interaction skills acquired within this context are being transferred and applied during other activities or daily routines. In line with that, it could be investigated how TES influences parent–child interaction when combination with traditional parent–child interaction training methods used in FLPs.

To conclude, this study shows that TES characteristics stimulate the quantity and quality of parent–child interaction and affect productive vocabulary of preschool children. After only two storytelling sessions, positive effects on children's productive vocabulary development were evidenced. The relations between TES characteristics and parent–child interaction showed that specific elements of TES generated contextualized and decontextualized parent–child interaction. Therefore, TES can be considered as an effective learning context for both parent and child.



Chapter 4

Helping parents enhance vocabulary development in preschool children: effects of a family literacy program

Based on

Teepe, R. C., Molenaar, I., Oostdam, R. J., Fukkink, R. G., & Verhoeven, L. (2017). Helping parents enhance children's vocabulary: effects of a family literacy program. *Revised manuscript resubmitted, Early Childhood Research Quarterly.*

Abstract

Family literacy programs seek to improve how parents develop their children's vocabulary. The effects of these programs are limited, partly because they appear to give insufficient guidance and support to parents in changing how they interact with their children. To increase the impact of family literacy programs, two ways to support parents in changing their interaction behavior were examined: active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL). The effects on vocabulary were investigated in children involved in preschool education programs. In a quasi-experimental design, 223 preschool children were enrolled in a family literacy program with AL, TL or in the control condition without a family literacy program. Results showed that children in the AL condition made larger receptive vocabulary gains than control children, whereas TL children showed similar gains to controls. Children in all three conditions made similar gains in productive vocabulary. These results demonstrate the strength of AL and show the complexity of implementing TL.

Introduction

Early vocabulary is a powerful predictor of reading and writing proficiency and is related to a successful school career (Dickinson, Griffith, Michnick Golinkoff, & Hirsh-Pasek, 2012; Torppa et al., 2007). Vocabulary development in preschool children is largely determined by social interactions during parent-child activities in the home environment (Hoff, 2003; Rowe, 2012). Family literacy programs seek to enhance children's vocabulary development by training parents' interaction behavior and providing language stimulating activities to be conducted at home (Sénéchal & Young, 2008). Yet these programs yield only limited effects, probably because they seem to provide insufficient support to parents in changing their interaction behavior at home (Blok, Fukkink, Gebhardt, & Leseman, 2005; Grindal, Bowne, Yoshikawa, Schindler, Duncan, Magnuson, Shonkoff, 2016; McElvany & Artelt, 2009; Van Steensel, McElvany, Kurvers, & Herppich, 2011). In this study, we examined two ways of supporting parents' interaction behavior with the aim of increasing the impact of family literacy programs: active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL). In a large-scale intervention study with Dutch children involved in preschool education programs, we examined the potential benefits of a family literacy program including AL or TL for vocabulary development.

Vocabulary development via parent-child interaction

Parent-child interaction is considered to be a key factor in the vocabulary development of preschool children (Hoff, 2003a). Two aspects of parent-child interaction have been found to relate to children's vocabulary development: the amount of high quality linguistic input and the degree of sensitive responsiveness. Linguistic input is of high quality when parents provide diverse and sophisticated vocabulary (Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010), open-ended questions (Mol, Bus, de Jong, & Smeets, 2008) and decontextualized language beyond the here and now (Hoff & Naigles, 2002; Van Kleeck, 2008). Children who engage in frequent high-quality interactions with their parents have larger vocabularies and develop vocabulary at a faster rate than children who are involved in fewer and lower quality interactions (Hoff, 2003a; Rowe, 2012).

The extent to which parents adjust linguistic input to their child's cognitive and emotional needs is essential for fostering children's vocabulary development (Landry, Smith, & Swank, 2006). In attachment theory this is referred to as sensitive responsiveness (Ainsworth, Blehar, Waters, & Wall, 1978).

Recognizing children's needs and providing contingent behavior contributes to secure parent–child attachment which is considered the basis for parent-child interaction. Providing emotional support (i.e., warmth, acceptance and encouragement; Landry et al., 2006), respecting children's autonomy by treating them as unique individuals (Erikson, 1950), and structuring and limiting settings by providing clear expectations of children's behavior are prerequisites in this respect (Thompson, 1998). These parent behaviors contribute to a safe, consistent and stimulating home environment in which young children can develop their social and cognitive abilities.

Family literacy programs to enhance children's vocabulary development

One way to increase children's vocabulary is by supporting parents. Family literacy programs aim to train parents how to interact with their children and provide stimulating parent-child activities (such as story books, craft materials, games) to be conducted at home (Sénéchal & Young, 2008). By focusing on the way parents interact with their children, family literacy programs aim to make permanent, positive changes in the routines of family life and aim to promote long-term vocabulary development (McElvany & Artelt, 2009; Van Steensel et al., 2011).

Recently, several meta-analyses on the effects of family literacy programs on vocabulary have been conducted, both as stand-alone programs and in combination with preschool programs. Blok and colleagues (2005) focused on the effects of combined and stand-alone family and preschool programs. They found a moderate overall effect size of both program types (Cohen's $d = 0.32$), whereas combined family literacy and preschool programs were 0.5 SD more effective than stand-alone family literacy programs (Blok et al., 2005). They also found that programs including coaching of parenting behavior were positively related to outcomes in the cognitive domain. Van Steensel and colleagues (2011) focused on the effects of stand-alone family literacy programs and examined whether certain program characteristics, including combining a family literacy program with a preschool program, moderated vocabulary effects. They found a small overall effect of family literacy programs (Cohen's $d = 0.18$). No moderator effect was found for family literacy programs combined with preschool programs. In a more recent meta-analysis, Grindal and colleagues (2016) examined the effects of combined family literacy and preschool programs on children's cognitive and pre-academic skills and found no effects of family literacy programs in addition to preschool programs. However, they

did find suggestive evidence ($p < .10$) that family literacy programs in which interaction behavior was systematically modeled and practiced with parents was associated with greater effects on children's pre-academic skills (such as reading, counting and letter recognition).

Most studies included in these meta-analyses were based on effects on general receptive vocabulary tasks that did not relate to program content, as opposed to curriculum-based tasks that measure program-specific vocabulary. Curriculum-based tasks provide insight into the learning process within the program, whereas general vocabulary tasks demonstrate the transfer of this knowledge to vocabulary outside the program context (Espin, Shin, & Busch, 2005). Moreover, vocabulary exists in a continuum in which receptive knowledge (understanding words) can be seen as a precursor to productive knowledge (actively using words) (Nagy & Scott, 2000). Possibly, the effects of family literacy programs on vocabulary growth are underestimated by the use of general receptive vocabulary tasks. Acknowledging the methodological advances of standardized vocabulary tests, effects of family literacy programs could be identified in more detail when measured using receptive and productive curriculum-specific and standardized vocabulary tests.

Overall, the meta-analyses demonstrate positive vocabulary effects from family literacy programs, particularly when parents receive intensive coaching and training, although their impact appears limited. Researchers argue that these small effects may be due to insufficient guidance and support of parents in the programs (Grindal et al., 2016; McElvany & Artelt, 2009; Van Steensel et al., 2011). The approaches most family literacy programs use to change interaction behavior may be insufficient to produce significant changes that are sustained in daily interactions at home (Grindal et al., 2016). Parents are often trained in parent group meetings during which they are provided with information about parenting or child development. These meetings tend to focus on general parenting topics and provide limited active learning opportunities for parents to experience and practice the targeted interaction behavior. Moreover, parent meetings are often conducted by paraprofessional volunteers who have limited theoretical background knowledge (Van Steensel et al., 2011). Video observation of parent-child interactions has demonstrated that, as a result, parents were not able to give high quality linguistic input and sensitive responsiveness at home because the structure of parent-child conversations, the quantity of parental feedback, and the extent of parental guidance were unsatisfactory (McElvany & Van Steensel, 2009). Following Van Steensel and colleagues (2011), we can conclude that, if parental support is not

optimal, implementation in the homes is likely to be limited, which limits the added value of family literacy programs for children's vocabulary development.

Alternative ways to support parents

One way to optimize parental support, is by engaging parents in active learning activities (Kaminski, Valle, Filene, & Boyle, 2008). Active learning can be defined as 'involving students [parents] in *doing* things and *thinking* about what they are doing' (Bonwell & Eison, 1991, p. 19). In contrast to passively listening to information provided by teachers, active learning stimulates parents and engages them in higher-order thinking about their own behavior (Kaminski et al., 2008). Active learning activities include modeling, opportunities to practice, and interactive discussions to evaluate interaction behavior. Observing teachers modeling interaction behavior (such as interactive story-book reading with open-ended questions) allows parents to create a mental representation of the proposed behavior (Bandura, 1971). Retention of this behavior can then be supported when the observed behavior is brought into practice, for example by pretend play and role play, and evaluated in interactive discussions. Modeling high quality and sensitive responsive interactions and providing opportunities to practice, is more likely to increase this behavior in parents and therefore children's vocabulary development, compared to passive learning (Grindal et al., 2016).

When implementing active learning activities in parent group meetings, one should be aware of challenges, both for the teacher and parent (Bonwell & Eison, 1991). Active learning activities require highly developed teacher skills, such as being a role model, stimulating parents and creating a comfortable and safe atmosphere for activities to take place. For parents who are familiar with a more passive listening role, active learning might be strange and out of their comfort zone. Moreover, parents have to transfer the acquired interaction behavior to at-home activities with their child. Therefore, teachers should be extensively trained in creating a safe and participatory learning environment for active learning to be effective, including transfer of interaction behavior to the home environment.

An alternative way to support parent's interaction behavior and to stimulate this behavior taking place in the home environment is by using technology-enhanced learning that provides real-time interaction support. Recent studies have shown that technology-supported literacy activities, such as technology-enhanced storytelling, can foster parent-child interaction and children's vocabulary development (Gremmen, Molenaar, & Teepe, 2016; Teepe, Molenaar,

& Verhoeven, 2016). Technology-enhanced storytelling includes real-time visual, auditory and textual interaction prompts and can generate high-interaction quality including decontextualized language beyond the here and now (Teepe et al., 2016). One of the advantages of technology-enhanced storytelling is that it requires no transfer of interaction behavior learned in a parent meeting to the home environment. As parents receive real-time interaction support, this type of activity may facilitate sustained changes in parents' interaction behavior in the home. It should however be implemented with caution, as implementation of technology-enhanced learning seems to depend largely on both the teacher's and parent's computer skills, their attitudes towards technology-enhanced learning such as technological self-efficacy, and the teacher's technological pedagogical knowledge (Marakas, Yi, & Johnson, 1998; Voogt, Fisser, Pareja Roblin, Tondeur, & Braak, 2012). Therefore, it is important that teachers are trained and that parents are intensively guided in their use of technology-enhanced learning activities at home.

Present study

One of the major challenges is to support parents in such a way that high quality and sensitive responsive input are sustained in daily home interactions. In this study, an effort has been made to examine the effects of a Dutch family literacy program with AL and TL on children's vocabulary development. In the AL condition, parents were involved in parent meetings that included modeling, role play and interactive discussions. In the TL condition, the focus of the parent meetings was on technology-enhanced storytelling with real-time interaction support. AL and TL children were compared to a control condition consisting of children involved in a preschool program. The main research question was: what is the effect of a family literacy program including active learning or technology-enhanced learning on general and curriculum-based vocabulary development of preschool children? The effects of AL and TL were investigated combined with a preschool program and determined with multiple vocabulary tasks (i.e., general and curriculum-based receptive and productive).

Method

Sample and design

The present study is part of Parents in Preschool Education in the Netherlands (see also Teepe et al., 2017) in the Netherlands. Dutch preschool organizations were approached to participate along with their preschools. Preschools were included if they met all Dutch policy quality standards for preschool education

(i.e., a maximum class size of 16 children, child-to-teacher ratio of 16:2, a qualified center-based program and preschool teachers who have received specialized center-based training). Moreover, preschools were only included if the teachers had no prior professional experience with a family literacy program. Thirteen preschools (two to six per preschool organization) met the inclusion criteria and were willing to participate.

Because of policy constraints, we used a controlled quasi-experimental design to allocate preschools to the AL, TL or control condition. Four preschools were required by their local policy to start with a family literacy program that particular school year and were randomly assigned to AL or TL. The remaining nine preschools were randomly assigned to one of three conditions. This resulted in four AL preschools (n = 72 children at the start of the project), four TL preschools (n = 73) and five preschools participating as a control group (n = 78). Each participating preschool had, on average, 17 parent-child dyads, ranging from eight to 30 dyads.

Preschool teachers recruited families via a brochure and introductory meeting. The age inclusion range for the children was 30-39 months (2.6-3.3 years of age), following program guidelines and taking into account that children older than 39 months would enter formal schooling before the end of the study. A total of 223 preschool children (M_{age} = 35.4 months, SD_{age} = 3.5 months) started the study, of whom 43.5% (n = 97) were girls. Following the standard procedure in Dutch preschool education, all children attended the preschool two to four half-days (6 to 12 hours) per week.

Children came from linguistically diverse backgrounds. In 108 families (48.4%) only Dutch was spoken at home with these children learning Dutch as a first language (L1). In the other families (n = 115) either a combination of Dutch with other language(s) or only other language(s) were spoken at home (with a total of 48 different languages including Moroccan, Turkish, Polish, Farsi, Papiamento). These children learned Dutch as a second language (L2). The ratio of L1/L2 children within preschools varied from 20.0% to 94.4% L2 children. Of 223 participating parents, 86.1% were mothers. The highest education level of the mother was used as a measure for educational level, based on maternal education being the most robust sociodemographic predictor of child development (Bornstein, Hahn, Suwalsky, & Haynes, 2003). Educational level was measured on a six-point-scale ranging from no education (1) to university (6) and showed a mean of 4.4 (SD = 1.2). There was a small bias because for one preschool (n = 18 children), the percentage of lower educated mothers was fairly high (33.3%), whereas for three other preschools (n = 18 to 25 children) the percentage of higher educated

mothers was high (60% to 76.2%). Linguistic diversity and mother's educational level were included as covariates.

The study involved 46 female preschool teachers with two to four teachers per preschool. The high ratio of teachers to preschools (N = 13) is due to governmental guidelines stipulating a 16:2 child-to-teacher ratio as well as to most teachers working part-time. Teachers' ages ranged from 27 to 60 (M = 47.38, SD = 7.95 years). 37 teachers had completed vocational education (80.4%), eight higher professional education (17.4%) and one university education (2.2%). All teachers were experienced professionals with over five years of work experience. Differences across conditions on participant characteristics are presented in the results section after taking into account attrition.

Intervention

The family literacy program used in the current study was the Dutch program 'Early Education at Home' (In Dutch: *VVE Thuis*, developed by the Dutch Youth Institute, 2014). The key element of the program was to improve linguistic input quality and sensitive responsiveness. To achieve this, the program classified theoretical elements of input quality and sensitive responsiveness (Ainsworth et al., 1978; Hoff, 2003a) into five general guidelines for parent-child interaction. These guidelines were 1) involve your child in conversations, 2) encourage your child, 3) provide rules and structure, 4) recognize your child's needs, 5) provide autonomy. The general guidelines were used to provide practical examples of specific interaction behavior during the parent meetings. Every six weeks parents received a workbook with eight activities to be conducted at home (i.e., shared reading, storytelling activities, memory games, puzzles, songs and rhymes, arts and craft activities, and daily activities). During 1.5-hour parent group meetings, parents were trained on interaction behavior to be performed during these activities. Parent groups consisted of, on average, 12 parents (ranging from 6 to 25 parents, with the larger groups being divided into subgroups during the meeting) to allow active intra-group interactions. The program was aligned with the preschool program, with the same four six-weekly themes and content offered at the same time.

Active learning during group meetings (AL)

Teachers were familiarized with the family literacy program, including AL, via an information session (2 hours), training session (4 hours) and two 1-hour coaching sessions after the first two parent meetings (all provided by the first author). The focus of the AL training and coaching was on active learning

activities to be conducted with parents. We trained teachers how to model, practice and interactively discuss the activities and proposed interaction behavior. During the training, teachers evaluated video examples of parent-child interactions, practiced with modeling activities (for example shared reading), and conducted interactive discussions about program materials and interaction behavior. In addition, teachers were informed how to create a safe and active learning environment. In the coaching sessions, the first author provided feedback on the active learning activities used by the teacher during the parent group meeting.

Teachers were requested to start the parent group meetings by evaluating the preschool and family literacy program activities from the preceding theme. They had to interactively discuss how activities had been conducted, what parents had learned from it and what difficulties they had experienced. The focus of this evaluation was on parents' ability to apply the five general interaction guidelines at home. We suggested that teachers next introduced the new theme. They were asked to go through all the activities of the programs' workbook by using modeling techniques, role play, conducting activities together and interactively discussing activities. Again, teachers were asked to focus on parents' interaction behavior during these activities. In addition, we invited teachers to show concrete preschool materials (books, toys, games) to explain parallels between the preschool and family literacy program.

Technology-enhanced learning (TL)

TL teachers were, as with AL teachers, familiarized with the family literacy program and TL via an information session (2 hours), a training session (4 hours) and two 1-hour coaching sessions after the first two parent meetings. The focus of the TL training and coaching was to make teachers familiar with the tablet computer and the technology-enhanced storytelling activity Jeffy's Journey. Jeffy's Journey was a digitized version of one of the program activities. It involved shared verbal storytelling supported by a story structure and real-time visual, auditory and textual prompts (Teepe, Molenaar, & Verhoeven, 2016). It consisted of four storytelling phases that guided parent and child through creating a meaningful story together. For each character in the story, they could select visual, auditory and textual storytelling prompts, such as emotion changes and open-ended questions. There was also a digital instruction available with screenshots of the activity and audio instruction. We trained teachers how to conduct technology-enhanced storytelling, how to explain the concept to parents and how to facilitate transfer of the interaction

behavior to other program activities. During the training, teachers were told about the functions of the tablet computer, practiced technology-enhanced storytelling, and conducted an interactive discussion on interaction behavior during technology-enhanced storytelling. During the coaching sessions the first author provided feedback on the delivery of technology-enhanced storytelling by the teacher during the parent group meeting.

Teachers were instructed to first evaluate the preschool and family literacy program activities of the preceding theme. They had to interactively discuss how technology-enhanced storytelling and program activities had been conducted, what parents had learned from it and what difficulties they had experienced. We advised teachers to focus on parents' ability to apply interaction behavior during technology-enhanced storytelling and the transfer of this behavior to other program activities. Next, teachers were asked to introduce the new theme. They introduced the technology-enhanced storytelling activity and had to discuss with parents how to use the same interaction behavior during other program activities. In addition, we asked teachers to show concrete preschool materials (books, toys, games) to explain parallels between the preschool and family literacy program. TL parents received a tablet computer (on loan) pre-loaded with Jeffy's Journey.

Treatment fidelity

To ensure the two groups of AL and TL teachers provided the same instruction during parent meetings they were provided with a manual containing a protocol explaining step-by-step what to address during each parent meeting and how to do it. In addition, three measures were used to assure treatment fidelity. In the first place, preschool teachers registered parent's presence at the four parent meetings. Parents who were not able to attend the meeting and instead received individual instruction were included as present. Second, participating parents were asked to record their program activities in a diary, with one diary per theme. Diaries were handed in at the end of each theme. The total number of diaries handed in was counted, ranging from 0 to 4. As a final measure of treatment fidelity, the number of program activities conducted in the course of the school year was calculated from the diaries.

Measures

Vocabulary

Children's vocabulary development was assessed by means of three vocabulary tasks: a receptive and a productive curriculum-based vocabulary task and a

general vocabulary task. The curriculum-based vocabulary tasks were designed to assess vocabulary in the four themes offered during the intervention period. From each of the four themes six words (nouns, verbs and adjectives) were selected with a total of 24 words. These words were comparable in their frequency in the program materials and suited the target group according to a Dutch wordlist for preschool children (Bacchini, Boland, Hulsbeek, Pot, Smits, 2005). These words were assessed productively and receptively.

In the productive task, children were shown a picture of the target word and simultaneously asked to complete a sentence in which the target word was left out (for example: The dog wags his ... [tail]?). For each correctly completed sentence, one point was assigned with a maximum of 24 points (Cronbach's *α* for pre- and post-test were .85 and .86). All responses other than the target word, including responses in other languages, were assigned a zero score. The receptive task followed the format of the Peabody Picture Vocabulary Test in which children had to select the picture of the target word from among three distracters (perceptual, phonological and semantic). Each correctly selected item was assigned one point, with a maximum of 24 points (Cronbach's *α* for pre- and post-test were .79 and .84).

General receptive vocabulary was assessed by the Dutch version of the Peabody Picture Vocabulary Test (PPVT-III-NL, Dunn & Dunn, 2005). In the PPVT, the child was orally presented one target word at a time. Out of four pictures he/she had to select the picture corresponding to the target word. The test was finished when the child gave nine or more incorrect responses within a set of 12 items. Each item was scored as one point, with a maximum of 175 points. Reported reliability (lambda-2-coëfficient) was excellent: between .89 and .90 for children of 2;3 to 3;5 years of age (Schlichting, 2010).

Covariates

Previous research (Teepe et al., 2017; Van Druten-Frietman, Denessen, Gijsel, & Verhoeven, 2015,) emphasized the role of certain child and family factors in explaining vocabulary. Children's age, gender, executive functioning and social functioning influence parent-child interaction and vocabulary development, as do linguistic diversity and educational level of the mother. Therefore, these factors were included in our models as control variables.

Executive functioning (EF). In line with previous research into preschool children's EF (Wiebe, Sheffield, Nelson, Clark, Chevalier, & Espy, 2010; Weiland, Barata, & Yoshikawa, 2014), the EF concept was operationalized with multiple tasks measuring different dimensions that cluster into a unitary EF construct. Each

task relied on a different but related EF component; a word repetition-string task measured working memory (Schlichting & Lutje Spelberg, 2010), the Hand Game (Hughes, 1996) measured response inhibition and the Dimension Change Card Sort measured attention shifting (DCCS, Zelazo, 2006). All tasks showed high internal consistency (Cronbach's $\alpha = .90$, $\alpha = .81$ and $\alpha = .73$ respectively). A Principal Component Analysis with Varimax Rotation showed one underlying factor with an eigenvalue >1, explaining 42.6 % of the total variance. Component loadings were .57 (working memory), .74 (response inhibition) and .64 (attention shifting). The composite score was calculated by adding up the *z*-score of the working memory task and the dichotomous scores of response inhibition and attention shifting. This was then divided by the number of tasks ((*z*-memory + response inhibition + attention shifting) / 3).

Social functioning (SF). Children's social functioning was measured by a subset of the Dutch KIJK! observation scale for preschool children (Van den Bosch & Duvekot-Bimmel, 2012), which was completed by preschool teachers. There were fifteen statements about how children behave with respect to peers and teachers (for example, 'the child is able to share with other children'). Items were scored on a 3-point-scale including 'not observed', 'partly observed' and 'entirely observed'. Internal consistency was high (Cronbach's $\alpha = .90$). This is in line with the validated kindergarten version (Van den Bosch & De Jaeger, 2000). Calculations were conducted on the mean score.

Background variables. Parents received a background questionnaire containing questions about their child (gender and date of birth) and about themselves (their educational level and language(s) spoken at home). Teachers also received a questionnaire with questions about their age, educational level and years of working experience.

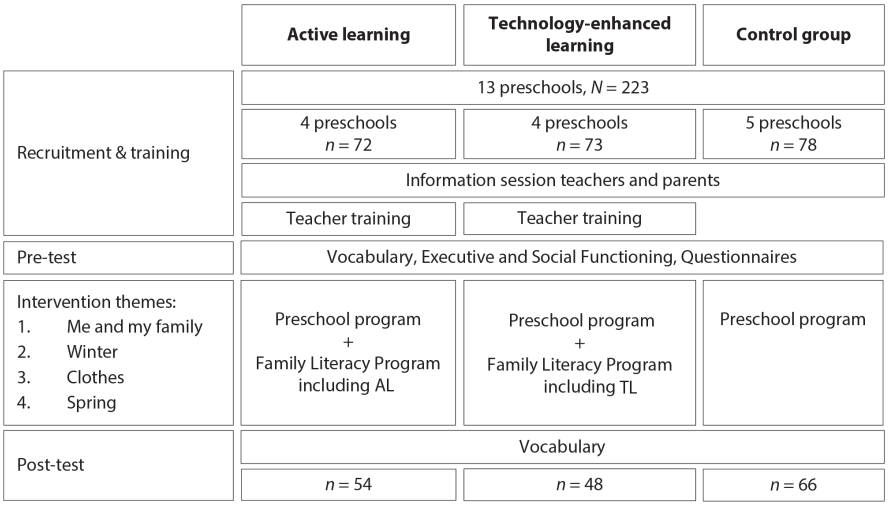
Procedure

An overview of the study's procedure is provided in Figure 4.1. The study took place from August 2014 to May 2015. In August, all teachers were provided an information session. At start of the school year, in September 2014, AL and TL teachers received their training, and information sessions for parents (AL, TL and control) were organized to inform them about the study and to ask them to participate. Before the start of the study, teachers gave active consent for their participation as did parents for their child's and their own participation.

The pre-test was performed in September 2014, when the majority of children had just entered preschool. Vocabulary and executive functioning tasks were administered in two separate sessions. Children were individually tested in

a quiet place outside the classroom. They were tested by eight trained test-assistants who followed strict testing protocols. At the time of testing, parents and teachers completed the questionnaires. Over the course of the school year, all children (AL, TL and control) participated in the same four six-weekly themes of the preschool program: Me and my family, Winter, Clothes and Spring. At the same time, AL and TL children and their parents were involved in the same four themes at home via the family literacy program. The testing procedure of pre-test was repeated at the end of the school year by the same test-assistants (May 2015). The study was approved by the Ethics Committee for Behavioural Research of Radboud University (dossier: ECG2013-0606-116).

Figure 4.1
Study overview with timeline for AL, TL and control condition



Analyses

We estimated, a priori, that a sample of 192 children (3 conditions * 64 children) was adequate to test the effect of our interventions with a two-sided test, an alpha of 0.05 and a statistical power of $\beta = .80$, assuming medium experimental effect (Cohen's $d = 0.50$). This effect size was based on previous studies on family literacy program effects (Lonigan, Escamilla, & Strickland, 2008; Mol et al., 2008; Van Tuijl, Leseman, & Rispens, 2001).

Attrition analysis showed that some children entered formal schooling earlier than expected because the children missing at post-test ($n = 35$) were significantly older than children who participated in all tests ($t(188) = -2.1$, p

= .044). These children did not differ in other demographic variables. Of 223 cases, 89 cases were incomplete because of missing values within a test or questionnaire (n = 34), children not being present during test administration (n = 8) or children being distressed during test administration (n = 12). Demographic data on the child (age, gender) and parent (educational level mother, linguistic diversity) was complete. To prevent information loss, missing data within tests and questionnaires was imputed at item level using Expected Maximization in SPSS 22 (IBM corp, 2013). Missing data on entire tests or questionnaires was not imputed. As a result, 34 of 89 cases (38.2%) with missing values could be included in the analysis resulting in a total of 168 cases. Of these children, 54 were in the AL condition, 48 the TL condition and 66 the control condition (also see Figure 4.1).

A multilevel regression analysis was conducted to account for the hierarchical structure of the data (children nested in preschools). Analyses were performed in MLwiN 2.35 (Rasbash, Steele, Browne, & Goldstein, 2009). Even though the intra-class correlation for the three dependent variables was small (ρ = .03 to .05), Kreft and De Leeuw (1998) demonstrated that even small values may inflate the alpha level resulting in an increased chance of a Type I error.

Models were constructed for each of the dependent variables using the same modeling procedure. We first entered the grand mean-centered pre-test scores (Hox, 2010; Snijders & Bosker, 1999). Second, we determined treatment fidelity and tested whether treatment fidelity of the AL and TL conditions (diaries handed in and presence at parent meetings) had an influence on program effects. In the third model, the experimental condition was entered. Finally, interactions between treatment fidelity and vocabulary measures variables were included, to evaluate whether the effect of treatment fidelity differed per condition.

Next, we tested whether AL and TL had an effect on vocabulary development, including all conditions. We first entered the pre-test. In the second model, control variables at child level were included: children's age, gender, executive functioning, social functioning, and linguistic diversity and mother's educational level. In the third model, the independent variable condition was entered. Condition was included as a categorical variable (AL = 1, TL = 2) with the control group as reference category (= 0). Teacher variables were available on preschool level (N = 13) and due to the limited number of cases at this level, these could not be included in the models. Effect sizes (Cohen's d) were based on the final models including all covariates.

Results

Treatment fidelity

Overall, parents attended on average 2.82 (*SD* = 1.36) of four parent meetings. Almost half of the parents, 46.1% (*n* = 47) attended all four meetings, but 9.8% (*n* = 10) attended none. Parents returned on average 2.44 (*SD* = 1.56) of four diaries. Of all parents, 34.3% (*n* = 35) returned all four diaries and 22.5% (*n* = 23) returned none. The quality of implementation can therefore be considered reasonable. Multilevel logistic regression analysis with Poisson distribution for count data (Kreft & De Leeuw, 1998) showed that parents in the TL condition attended significantly more parent meetings (*M* = 3.33, *SD* = 1.18) than parents in the AL condition (*M* = 2.37, *SD* = 1.34), (*B* = .341, *SE* = .118, *p* = .004). AL parents (*M* = 2.56, *SD* = 1.47) and TL parents (*M* = 2.31, *SD* = 1.66) returned similar numbers of diaries, (*B* = -.098, *SE* = .153, *p* = .522). Because of the relatively low diary return rate (34.3% returned all four diaries), the number of literacy activities conducted over the school year could not be computed and was therefore not included in further analyses. Bivariate correlations (Appendix C) show that presence at parent meetings and the number of diaries handed in were strongly associated (*r* = .70, *p* < .001). Further, there was a small negative association between presence at parent meetings and linguistic diversity at home, with the parents of L2 children attending less parent meetings (*r* = -.20, *p* = .010).

Table 4.1 shows that there was no effect of treatment fidelity on receptive, productive or general vocabulary. Both the number of diaries handed in and the number of parent meetings attended did not predict children's vocabulary scores. In other words, the variation in treatment fidelity did not moderate AL or TL effects. Interaction variables (condition*diaries handed in and condition*presence parent meetings) showed no influence of treatment fidelity within the two conditions either. Thus, treatment fidelity did not moderate condition effects.

Descriptive statistics for AL and TL

Table 4.2 presents descriptive statistics for vocabulary tasks (unadjusted by covariates) and covariates. The large standard deviations on the vocabulary tasks reflect the heterogeneity (i.e., varying linguistic background and educational levels of the mothers) of the sample. A preliminary analysis on the vocabulary pre-tests and covariates showed that children in the AL condition were slightly older than children in the control condition (*B* = 1.407, *SE* = 0.571, *p* = .014) and TL condition (*B* = 1.324, *SE* = 0.617, *p* = .032): these variables have been included

as covariates in the final model. Children from different conditions did not significantly differ on vocabulary pre-test scores or on other covariates. Bivariate correlations (Appendix C) showed that the strongest associations exist between the vocabulary pre- and post-tests (r = .55 to r = .80, p < .001). Moreover, the control variables executive functioning, social functioning and linguistic diversity were associated with vocabulary scores (r = .33 to r = .57, p < .001).

Table 4.1

Effects of treatment fidelity for the AL and TL condition (n = 102)

	Receptive vocabulary		**Productive vocabulary**		**General vocabulary**	
Fixed model	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Intercept	15.973	1.463	9.058	1.113	44.531	3.958
Pre-test	0.615**	0.088	0.897**	0.071	0.618**	0.070
Treatment fidelity						
Diaries handed in	0.249	0.417	0.318	0.311	0.248	1.165
Presence parent meetings	-0.116	0.458	-0.617	0.346	-0.175	1.232
Condition[1]	0.943	2.181	0.171	1.651	-6.881	6.049
Condition*Diaries handed in[1]	-0.466	0.553	-0.556	0.419	2.624	1.567
Condition*Presence parent meetings[1]	-0.366	0.684	0.670	0.514	-0.715	1.861
Random model						
Group level variance	0.115	0.653	0.000	0.000	0.000	0.000
Individual level variance	13.426**	2.068	7.694**	1.141	108.895**	16.056
Total variance explained	40%		66%		54%	
Δ-2* log likelihood	763.287		433.922		692.600	
χ^2 difference test[2]	$\chi^2(2) = 1.46$		$\chi^2(2) = 12.251^*$		$\chi^2(2) = 2.832^*$	

[1] The reference category (= 0) was the AL condition

[2] *Δ-2 Log Likelihood* was compared to the previous model without condition

* p < .05, ** p < .01

Table 4.2

Means and standard deviations on all variables for the AL, TL and control condition (*n* = 168)

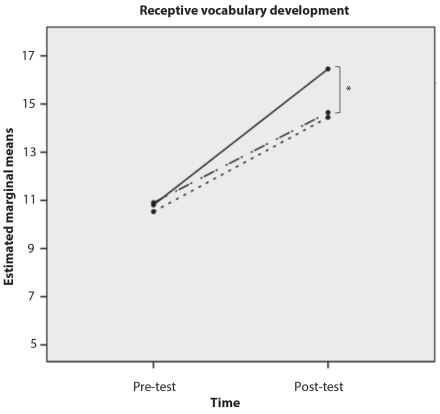
		AL (*n* = 54)		TL (*n* = 48)		Control (*n* = 66)	
	Min-max	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Vocabulary							
Receptive pre-test	0-24	11.30	4.77	10.33	4.19	11.55	4.39
Receptive post-test	0-24	16.57	4.41	14.67	5.00	14.94	4.92
Productive pre-test	0-24	5.58	4.32	4.49	4.22	5.50	4.07
Productive post-test	0-24	8.72	4.77	8.37	4.88	8.42	4.24
General pre-test	0-175	30.50	17.00	26.63	14.33	29.12	15.90
General post-test	0-175	45.54	12.79	39.35	17.16	41.63	14.85
Control variables							
Child age		36.87	2.94	35.54	3.37	35.50	3.06
Executive functioning		0.10	0.37	0.02	0.37	0.12	0.43
Social functioning		2.24	0.48	2.14	0.43	2.32	0.42
Linguistic diversity (L2)		50.0%		54.2%		42.4%	
Child gender (boys)		61.1%		45.8%		59.1%	
Education mother	0-6	4.61	1.09	4.19	1.18	4.38	1.02

Vocabulary effects of AL and TL

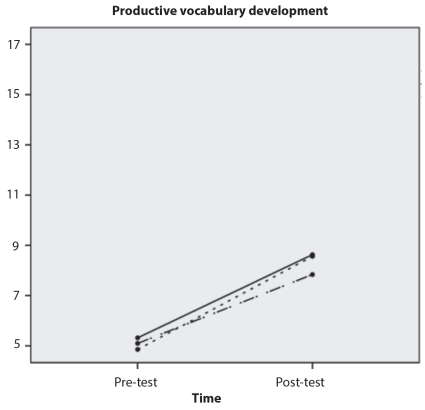
Final multilevel models for the three outcome variables receptive, productive and general vocabulary are presented in Table 4.3. Figure 4.2 presents a visual overview. For receptive vocabulary adding the pre-test to the model, showed a significantly better fit compared to the empty model (Δ-*2LL* = 71.397, *df* = 1, $p < .001$). The resulting Model 1 explained 36% of the total variance. The other covariates included in Model 2 significantly improved the model (Δ-*2LL* = 25.149, *df* = 6, $p < .001$) and explained an additional 6% of the variance. Linguistic diversity was related to receptive vocabulary, with L1 children having higher receptive vocabulary scores. The other covariates were not related to receptive vocabulary. In the final model condition was included. The resulting Model 3 had a significantly better fit than Model 2 (Δ-*2LL* = 6.631, *df* = 2, $p = .036$). There was an effect of condition, with children in the AL condition showing higher receptive vocabulary post-test scores compared to the control group ($B = 1.879$, $SE = 0.747$, $p = .012$). The size of this effect was moderate (Cohen's $d = 0.39$). The TL condition did not differ from the control condition ($B = 0.118$, $SE = 0.741$, $p = .112$, Cohens, $d = 0.02$). The final model explained 45% of the variance.

Figure 4.2

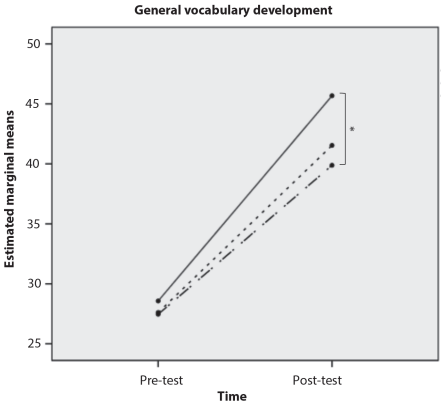
Receptive and productive vocabulary development for AL, TL and control conditions



Covariates appearing in the model are evaluated at the following values: child age = 35.62, child gender = .45, EF = .1000, SF = 2.2092, mother education = 4.34, linguistic diversity = .4903



Covariates appearing in the model are evaluated at the following values: child age = 35.66, child gender = .45, EF = .1069, SF = 2.2260, mother education = 4.33, linguistic diversity = .4968



Covariates appearing in the model are evaluated at the following values: child age = 35.64, child gender = .44, EF = .1042, SF = 2.2211, mother education = 4.33, linguistic diversity = .4969

For productive vocabulary, adding the pre-test to the model resulted in a significantly better fit compared to the empty model (Δ-*2LL* = 168.48, *df* = 1, *p* < .001) and explained 65% of the total variance. In Model 2, other covariates were included which significantly improved model fit (Δ-*2LL* = 17.577, *df* = 6, *p* = .009). Linguistic diversity also predicted productive vocabulary, with L1 children showing higher productive vocabulary scores. The other covariates were not related to productive vocabulary. Including condition did not improve model fit (Δ-*2LL* = 1.585, *df* = 2, *p* = .460), and there was no effect of condition. The final model explained 68% of the total variance.

For general vocabulary, adding the pre-test to the model explained 47% of the total variance and showed a significantly better fit than the empty model (Δ-*2LL* = 116.034, *df* = 1, *p* < .001). In Model 2, the covariates executive and social functioning significantly related to general vocabulary. Compared to Model 1, model fit significantly improved (Δ-*2LL* = 43.110, *df* = 6, *p* < .001). In the final model, condition was included. There was a significant condition effect: children in the AL condition had significantly higher general vocabulary scores than the control group (*B* = 4.846, *SE* = 2.022, *p* = .0016, Cohen's *d* =0.32), whereas the TL condition did not differ from the control group (*B* = 1.848, *SE* = 2.058, *p* = .369, Cohen's *d* = 0.12). The resulting Model 3 had a better fit than Model 2 (Δ-*2LL* = 5.475, *df* = 2, *p* = .065) and in total 58% of the variance was explained. To summarize, there was a positive effect of AL on curriculum-based receptive vocabulary and general vocabulary.

Table 4.3

Final multilevel models for receptive, productive and general vocabulary (*n* = 168)

	Receptive vocabulary		Productive vocabulary		General vocabulary	
Fixed model	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Intercept	16.02**	1.336	8.656**	0.968	36.629**	3.708
Pre-test	0.481**	0.081	0.680**	0.075	0.433**	0.069
Age	0.018	0.102	-0.047	0.073	-0.530	0.289
Gender (1 = girl)	1.281*	0.629	0.223	0.443	0.004	1.709
Executive functioning	0.520	0.447	0.442	0.331	2.680*	1.228
Social functioning	0.741	0.823	0.903	0.601	7.462**	2.234
Linguistic diversity (1 = L1)	1.750**	0.655	1.475**	0.546	2.587	1.945
Education mother	0.069	0.270	0.072	0.194	1.160	0.749
Condition (0 = control)						
Active learning	1.879*	0.747	0.479	0.663	4.846*	2.022
Technology-enhanced learning	0.118	0.741	0.866	0.654	1.848	2.058
Random model						
Group level variance	0.000	0.000	0.317	0.358	0.000	0.000
Individual level variance	12.647**	1.501	6.304**	0.780	96.882**	11.378
Total variance explained	45%		68%		58%	
Δ-2* log likelihood	763.287		674.713		1074.648	
χ^2 difference test[1]	$\chi^2(2) = 6.631$*		$\chi^2(2) = 1.585$		$\chi^2(2) = 5.475$	

* $p < .05$, ** $p < .01$

[1] *Δ-2 Log Likelihood* was compared to the previous model without condition

Discussion

In this study, we examined the effects of a family literacy program that included active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL) on vocabulary development of children attending preschools. There was a positive effect of the family literacy program delivered via AL on both curriculum-specific and general vocabulary development. Children involved in AL had larger receptive vocabulary gains compared to control children who were only involved in a preschool program. Their productive vocabulary gains were the same. No evidence was found for vocabulary benefits of the family literacy program including TL.

These results show strong support for the proposed mechanism that training parents' interaction behavior via active learning activities in a family literacy program facilitates children's vocabulary development. Effects of this approach were established on both receptive curriculum-based and general vocabulary development. Research has repeatedly concluded that changing parents' interaction behavior is challenging (Grindal et al., 2016; Halpern, 2000). Moreover, programs that target the behavior of parents are less likely to have positive effects than programs that directly target children (Blok et al., 2005). This study demonstrates that involving parents in active learning activities, such as modeling, opportunities to practice and interactive discussions to elaborate on interaction behavior, is an effective way to produce changes in their children's vocabulary development.

Using different vocabulary tasks, our study contributes to existing literature (i.e. Grindal et al., 2016; Van Steensel et al., 2011) by providing a fine-grained picture of AL program effects. This picture showed that AL particularly improved receptive vocabulary development (curriculum-based and general). It indicates that children understand vocabulary used inside and outside the program, but that they were not yet able to actively use curriculum-based vocabulary because no effects on productive vocabulary development were found. As vocabulary exists on a continuum where receptive vocabulary precedes productive knowledge (Nagy & Scott, 2000), we assume that program effects on productive vocabulary develop at a later moment in time. These results stress the importance of measuring program effects with different vocabulary tasks.

Compared to previous studies measuring effects of family literacy programs (Van Steensel et al., 2011), the effect sizes of AL, with Cohen's d = 0.32 and 0.38, are substantial and amount to a small-to-medium effect. The size of the experimental AL effect is larger than aggregated effect sizes from meta-analytic studies (Blok et al., 2005; Grindal et al. 2016; Kaminski et al., 2008),

who generally report small effect sizes. Further, parents were trained during a limited number of parent meetings (four, one for each theme) and the intervention period of 24 weeks was fairly short. Treatment fidelity measures showed that program implementation was adequate with a number of parents not attending all parent meetings. Moreover, because of the heterogeneous nature of the sample, teachers were faced with the challenge of training parents of different linguistic, educational and cultural backgrounds in one group. These restrictions and challenges, and the relatively small sample (n = 168), underscore the strength of the AL intervention. Thus, combining a family literacy program focused on active learning activities with a center-based program is an effective way of stimulating children's vocabulary development.

Contrary to our expectations, children in the family literacy program including TL did not outperform children in the control group on the vocabulary tasks. In a more artificial study where parent training was performed by researchers rather than teachers, Teepe and colleagues (2016) did find that technology-enhanced storytelling with parents receiving real-time interaction support, fostered parent-child interaction quality and children's vocabulary development. This effect was not replicated in the naturalistic setting of a family literacy program in which teachers implemented the program. TL works in a controlled setting, but implementation in the complex setting of the preschool has greater challenges.

A first challenge was familiarizing the preschool teachers with TL. Even though we extensively trained teachers, it seemed that we were not able to completely familiarize them with the tablet computer and the technology-enhanced storytelling activity, and provide them with the required technological self-efficacy. As Voogt and colleagues (2012) emphasized, effects of technology-enhanced learning largely depend on teachers' computer skills and their technological self-efficacy. As a result of their limited knowledge and skills, transfer of the activity to parents during the group meetings was not optimal. TL parents visited significantly more parent meetings than AL parents, which might reflect their need of more instruction. A second challenge was the technological issues that both teachers and parents faced. In some preschools, no wifi connection was available to update the activity and some tablets were repeatedly giving errors. These problems hampered successful transfer during the parent meetings and as a consequence may have impeded the implementation at home as well.

The lack of TL effects could also be more program related. TL consisted of one technology-enhanced activity and eight regular program activities. The impact of one technology-enhanced storytelling activity might have been too small to establish a transfer to other activities and an increase in children's vocabulary development. To conclude, technology-enhanced storytelling does work in a controlled setting, yet it is challenging to successfully implement it in a more naturalistic setting where challenges are faced and greater intensity is required.

Some limitations should be mentioned. Firstly, policy constraints did not allow us to randomly assign preschools to conditions. Even though no significant differences between conditions were found at pre-test, possible selection effects cannot be fully excluded. Second, our sample suffered from attrition which resulted in reduced statistical power. Although we recruited 15% more children than estimated with a power-analysis (223 children were recruited versus the required 192), the final dataset included 168 cases because of randomly missing data. Finally, this study included a quite heterogeneous sample, including families of diverse linguistic, educational and cultural backgrounds. By including background variables as covariates, we could reduce the large variance and provide a clear picture of actual program effects. At the same time, it is difficult to conclude which families benefit from the program. The limited sample size did not allow us to further investigate differential learning gains for different subgroups. To save costs in terms of program materials and teacher efforts, future research must consider the impact of the program for different subgroups.

There are further recommendations for future research regarding program components and design characteristics. In the current study, transfer of the program and training parents' interaction behavior was conducted via parent group meetings. Previous research has shown that parent-child interaction and children's vocabulary especially benefits from home visits (Grindal et al., 2016, Kaminski et al., 2008) because home visits can facilitate the transfer of interaction behavior learned in the parent meeting to the home environment. To further increase the impact of family literacy programs, future research should consider investigating the effect of combining these two effective components.

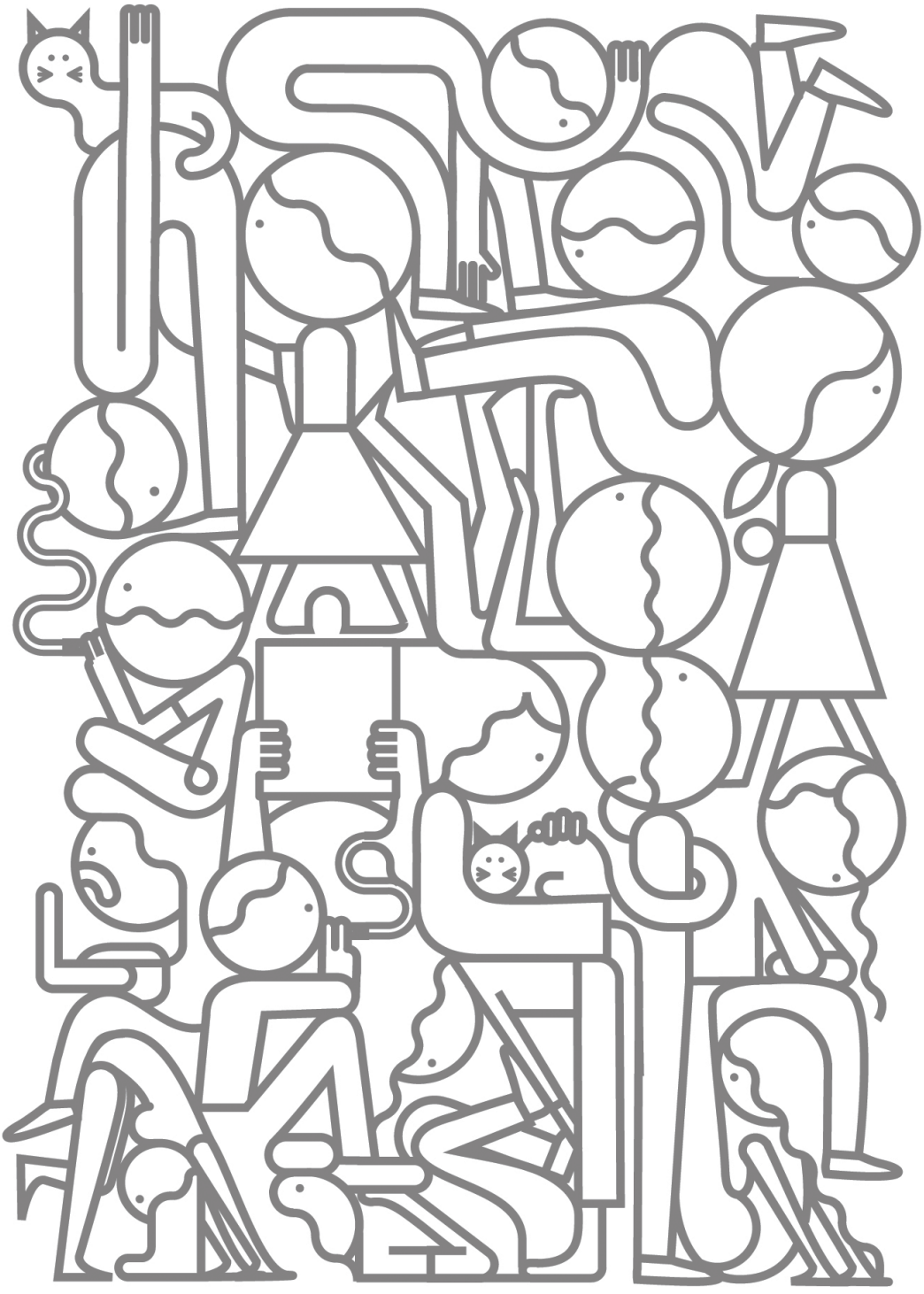
It also remains to be determined how the program influenced the quality and sensitivity of linguistic input provided by parents. The current study focused on child outcomes, whereas Kaminski and colleagues (2008) showed that taking into account both parental and child outcome measures provides a complete picture of program effects. Future studies could therefore include, for

example, a measure of the technological self-efficacy of teachers or a measure to chart parent interaction behavior in detail before and during the program. This would provide a reflection of the full proposed mechanism of vocabulary development via teacher instruction at parent meetings and parent-child interaction at home. In addition, follow up measures would provide insight into the sustainability of the vocabulary gain and parents' interaction behavior over a longer period of time. As a final recommendation, we suggest conducting more research into how programs are actually implemented. In addition to the more quantitative implementation measures included in the current study, future research could include more qualitative implementation measures, such as the quality of transfer from trainers to parents.

The main strength of this study is that two different approaches to supporting the interaction behavior of parents were examined at the same time. To identify the effects of each approach a rigorous study design was applied, including three different vocabulary tasks to establish program effects and several measures to identify implementation quality. Moreover, AL and TL were investigated within the same family literacy program to eliminate program effects, and they were compared to a strong control group that was involved in the same themes in preschool. In addition, the study was conducted in a naturalistic school setting which contributes to the external validity, with parents being trained by preschool teachers rather than by researchers. Finally, in the analyses, theoretically relevant covariates were taken into account to control for the heterogeneity of our sample and to provide a clearer picture of actual program effects.

Conclusion

The present findings demonstrated that receptive curriculum-based and general vocabulary development of preschool children benefits from a family literacy program in which parents are involved in active learning activities during parent group meetings. A family literacy program including technology-enhanced learning seemed to have no effect on children's vocabulary development. These results demonstrate the challenges that are faced when implementing technology-enhanced interventions. Above all, it shows the important role both teachers and parents play in stimulating children's vocabulary at home.



Chapter 5

Measuring the impact of a family literacy program on preschoolers' receptive and productive vocabulary using curriculum-based tasks

Based on
Teepe, R. C., Molenaar, I., Oostdam, R. J., & Verhoeven, L. (2017). Measuring the impact of a family literacy program on preschooler's receptive and productive vocabulary via curriculum-based tasks. *Manuscript submitted for publication*.

Abstract

The aim of this study was to investigate two ways of delivering family literacy programs: Active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL). To provide clear insight into how children respond to the interventions, curriculum-based receptive and productive vocabulary development tasks were administered four times over a one-year intervention period. We examined effects of AL and TL on preschool children's receptive and productive vocabulary development and evaluated whether these effects differed depending on family contextual factors (linguistic diversity and mother's education), and the child's executive and social functioning. Using a quasi-experimental design, 223 preschool children and their parents were enrolled in the AL, TL or control condition.

Research findings: Children in the AL and TL conditions made larger gains in receptive vocabulary than children in the control group, but not in productive vocabulary. Program effects did not differ depending on the family context or the child's functioning.

Practice or policy: Curriculum-based vocabulary tasks provide insight into actual program effects which is valuable for teachers, program developers and policy makers. AL and TL are an effective intervention to improve children's receptive vocabulary and they are equally effective for families and children with different backgrounds.

Introduction

Vocabulary is important for learning to read and write and to communicate with others (Dickinson, Griffith, Michnick Golinkoff, & Hirsh-Pasek, 2012; Torppa et al., 2007). Family literacy programs aim to enhance children's vocabulary by improving their parents' interaction behavior and providing language simulating activities to be conducted at home (Sénéchal & Young, 2008). Effects of family literacy programs are predominantly measured by general receptive vocabulary tasks that do not provide insight into children's learning processes within a program. To provide better insight to teachers, program developers and policy makers into how parents and children respond to family literacy programs curriculum-based vocabulary tasks measuring both children's receptive and productive vocabulary development were administered in this study.

Family literacy programs generally demonstrate positive effects, but often these effects are limited, probably because they provide insufficient support to parents in changing their interaction behavior at home (Grindal, Bowne, Yoshikawa, Schindler, Duncan, Magnuson, & Shonkoff, 2016; McElvany & Artelt, 2009; Van Steensel, McElvany, Kurvers, & Herppich, 2011). In this study, we examined two alternative ways of supporting parent's interaction behavior at home: active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL). Because vocabulary development is strongly associated with family contextual factors (mother's educational level and linguistic diversity) and the child's functioning (executive and social functioning), we investigated whether effects of AL and TL on curriculum-based vocabulary development differed depending on the child's functioning and the family context.

Measuring effects of family literacy programs

Effectiveness of early intervention programs is often established through general receptive vocabulary tests, such as the Peabody Picture Vocabulary test (Dunn & Dunn, 2005) or the Reynell Developmental Language Scales (Letts, Edwards, Schaefer, & Sinka, 2014). The advantage of these general vocabulary tests is that they are standardized and reliable measures that allow comparison of children with age-matched peers and the comparison of the effects of different programs. However, standardized tests provide primarily a reflection of children's general knowledge and understanding, and often lack the sensitivity to measure the actual response of children to interventions. Because standardized tests have to be generalizable to the entire population, they consist of test items that do not occur in the program and thus do not

measure the knowledge acquired within a program. As a consequence, the effects of family literacy programs may be underestimated. More importantly, because of their general nature, standardized tests do not provide teachers with information on how to improve children's vocabulary of a particular topic. Also, for program developers standardized tests provide very limited insight into which program components work well and which require improvement.

Curriculum-based assessment refers to an assessment model that emphasizes a direct relationship between an intervention and the child's development. As developed by Deno (1985), curriculum-based assessment uses repeated measures to evaluate the effectiveness of an intervention, with the main goal of creating more effective teaching methods and increasing learning gains. In the current study, this model was used to identify how children's receptive and productive vocabulary develops when involved in a family literacy program. Especially in preschool children, vocabulary development is a non-linear process with different numbers of words learned in any given time period, including large differences between children (Hoff, 2006). To identify how children respond to a program, it is therefore important to repeatedly measure their vocabulary and to also measure both their receptive (understanding and recognizing a word) and productive (being able to actively use a word) vocabulary development. This process-based approach of repeated curriculum-based measures provides a detailed reflection of their actual abilities and allows robust conclusions to be drawn. Moreover, such a process-based approach provides teachers and program developers specific information on how to adjust the instruction and the program to children's needs (Deno, 1985; Espin, Shin & Busch, 2005). Thus far, the use of curriculum-based vocabulary tasks in impact studies on family literacy programs has been very limited (Grindal et al., 2016; Van Steensel et al., 2011). To provide a clear picture of how children respond to family literacy programs, children's curriculum-based vocabulary development was measured four times during the intervention, both receptively and productively.

Family literacy programs to support vocabulary development

Early receptive and productive vocabulary development is essentially a social process that takes place via verbal interactions with family members, peers and teachers. Vocabulary exists on a continuum from not knowing a word, to varying levels of partial knowledge, to a more complete understanding of a word's meaning and, finally, the ability to use it in the appropriate context (Nagy & Scott, 2000). From this incremental view of learning, receptive vocabulary can be seen as a precursor for productive vocabulary. Children acquire receptive knowledge

by encoding linguistic input, matching a phonological representation to a referent and storing this link in their long-term memory (Sénéchal, Thomas, & Monker, 1995). For productive learning to take place, children need to retrieve the word from their working memory and use it appropriately in social interaction. Therefore, productive vocabulary development requires children to be verbally active participants in social interactions.

Family literacy programs aim to stimulate children's receptive and productive vocabulary by improving the quality and quantity of verbal interaction at home. By focusing on the way parents interact with their children, family literacy programs aim to make permanent, positive changes to the routines of family life and to promote long-term vocabulary development (McElvany & Artelt, 2009; Van Steensel et al., 2011). Recently, several meta-analyses of the effects of family literacy programs on vocabulary have been conducted (Blok, Fukkink, Gebhardt, & Leseman, 2005; Grindal et al., 2016; Van Steensel et al., 2011). Overall, these meta-analyses show positive vocabulary effects from family literacy programs, but their impact remains limited (Cohen's $d = 0.18$). It has been argued that these small effects may be due to insufficient guidance and support of parents in the programs to establish the targeted behavioral change in the home environment (Grindal et al., 2016; McElvany & Artelt, 2009; Van Steensel et al., 2011).

Parents are often trained during group meetings that tend to focus on providing general information about parenting and child development, with limited opportunities for parents to experience and practice the targeted interaction behavior. This does not allow parents to improve their interactional behavior enough. As a result, parents are not able to provide the high quality linguistic input at home that is necessary for the development of receptive vocabulary, and also do not sufficiently support their child's active participation in the verbal interactions that are required for the development of productive vocabulary (McElvany & Van Steensel, 2009). As a consequence, the added value of family literacy programs remains limited.

One way to increase the impact of family literacy programs is by improving the support parents receive. A first way to achieve this is by engaging parents in active learning activities (Kaminski, Valle, Filene, & Boyle, 2008). Active learning can be described as involving parents 'in *doing* things and *thinking* about what they are doing' (Bonwell & Eison, 1991, p. 19). With active learning activities, such as modeling, opportunities to practice, and interactive discussion, teachers engage parents in higher-order thinking about their own behavior (Kaminski et al., 2008). Whereas modeling activities allow parents to create

a mental representation of the proposed interaction behavior, interactive discussions and opportunities to practice (such as shared reading) support retention of the behavior (Bandura, 1971). Compared to passive listening, active learning activities are more likely to support parents' interaction behavior and hence children's receptive and productive vocabulary development (Grindal et al., 2016).

Another way of increasing the support that parents receive in family literacy programs is by providing real-time interaction support via technology-enhanced learning activities in the home environment. Recently, several studies have demonstrated that technology-enhanced learning activities, such as technology-enhanced storytelling, generate high quality parent-child interaction and foster children's vocabulary development (Gremmen, Molenaar, & Teepe, 2016; Korat, Shamir, & Heibal, 2013; Takacs, Swart, & Bus, 2015; Teepe, Molenaar, & Verhoeven, 2016). Technology-enhanced storytelling is a digital storytelling activity on a tablet computer that includes real-time visual, auditory and textual interaction prompts. It activates, for example, decontextualized language beyond the here and now (Teepe et al., 2016). An advantage of this type of support is that transfer of interaction behavior learned in the group meeting to the home environment is not required. The challenge for teachers' group meetings is to create awareness of interaction behavior and stimulate transfer to other, non-digital activities at home, such as shared book reading or memory games.

For whom are family literacy programs effective?

Already at preschool age (i.e., 2 to 4 years of age), there are large differences in children's receptive and productive vocabulary sizes and also in their developmental rate (Fenson et al., 1994). These differences are associated with family contextual factors and the child's executive and social functioning (Hoff, 2006; Teepe, Molenaar, Oostdam, Fukkink, & Verhoeven, 2017; Van Druten-Frietman, Denessen, Gijsel, & Verhoeven, 2015). Family contextual factors, linguistic diversity and the parents' educational level largely determine the quantity and quality of the linguistic input that children receive. Lower educated parents, in general, engage their child in fewer language stimulating activities (such as shared reading, memory games or singing songs), resulting in fewer opportunities for verbal interaction to take place (Hoff, 2006). Moreover, in lower educated families parents less often use diverse and sophisticated vocabulary (Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010), open-ended questions (Mol, Bus, de Jong, & Smeets, 2008) and decontextualized

language beyond the here and now (Hoff & Naigles, 2002; Van Kleeck, 2008). In linguistically diverse families, where a minority language is spoken at home, children receive less language input in the native language of the country they are growing up in. As a result, they encounter fewer opportunities to practice this language (Scheele, Leseman, & Mayo, 2010; Van Druten-Frietman et al., 2015). Therefore, children from lower educated and linguistically diverse families often have smaller receptive and productive vocabularies and develop vocabulary at a slower rate (Hoff, 2006).

With respect to the child's functioning, both children's executive and their social functioning are important predictors of early vocabulary (Teepe et al., 2017; Vitiello & Williford, 2016; Weiland, Barata, & Yoshikawa, 2014). Children's executive functioning (EF) is seen as the ability to control and regulate cognitive and behavioral processes (Mesulam, 2002). To abstract meaning from social interaction, EF helps children focus on and process multiple streams of language input and make decisions about word meanings based on the linguistic information available (Diamond, 2013). Their social functioning (SF) determines their ability to uphold social interaction. Children who understand the reciprocity of communication and their own contribution to this communication show higher levels of SF (Feldman, Bamberge, & Kanat-Maymon, 2013). Children with higher levels of SF engage in more conversations (McClelland, Morisson, & Holmes, 2000) and make greater vocabulary gains (Vitiello & Williford, 2016). Children with better developed EF and SF often have larger vocabularies compared to children who have developed these skills to a lesser extent (Teepe et al., 2017). Because children with smaller vocabularies are at risk for further language delays and being left behind in school (Sénéchal, Ouelette, & Rodney, 2006), it is important to help these children before they enter formal schooling.

The majority of family literacy programs strive to reduce vocabulary differences and aim to ensure that all children can make a successful start at school (Burger, 2010; Siraj-Blatchford, 2004). Along with identifying the general effects of AL and TL, the current study's aim is therefore to analyze AL and TL's potential to compensate for the differences between children that are related to the family context or the child's executive and social functioning. Relatively few studies have investigated the differential effects of early intervention programs and inconclusive findings have emerged from these studies (Burger, 2010; Reynolds, 2004; Van Steensel et al., 2011). In his systematic review, Burger (2010) examined the differential effects of early interventions. He found that studies do not consistently report that at-risk children (i.e., children with lower

EF and SF, or children from lower educated and L2 families) benefit more from these programs. In most reviewed studies, children benefit equally from early interventions, regardless of their family background, whereas in the remaining studies, programs are slightly more effective for at-risk children.

In line with this, Van Steensel and colleagues (2011) and Reynolds (2004) showed limited support for differential effects of early interventions and family literacy programs. Van Steensel and colleagues found no moderator effects for sample characteristics (i.e., educational status and age group). Reynolds, who investigated the effects of one specific program (the Child-Parent Center program), did show that there were indications that children from the highest poverty neighborhoods benefitted most from the intervention. These inconclusive results indicate that differential effects of early interventions may depend on the program and educational situation in which a program is implemented. Therefore, the aim of this study was to provide recommendations for policy and practice regarding the differential effects of AL and TL on children's vocabulary development.

This study

Our study aims to contribute to the current literature in several ways. First, extending research that has used standardized vocabulary pre- and post-tests to establish effects, we used curriculum-based vocabulary tests, repeatedly measuring both children's receptive and productive vocabulary during the one-year intervention period. Second, we examined the effects of a family literacy program distinguishing between two alternative approaches to support the interaction behavior of parents; active learning activities during group meetings (AL) and technology-enhanced learning with real-time interaction support (TL) on preschool children's curriculum-based receptive and productive vocabulary development. Finally, based on both family contextual factors and the child's executive and social functioning, we examined which groups of children benefits most from the family literacy program with AL and TL. Differential effects of family literacy programs have received little attention and results are inconclusive. The following research questions were central to this study:

1. What is the effect of AL and TL on preschoolers' curriculum-based receptive and productive vocabulary development?
2. Do AL and TL effects differ depending on the child's executive and social functioning and the family context?

With respect to the first question, we hypothesized that children involved in a family literacy program with AL and TL would outperform children in a control group who were not involved in a family literacy program. This is based on positive effects of active learning activities and technology-enhanced learning activities as demonstrated in previous studies (Bandura, 1971; Gremmen et al., 2016; Grindal et al., 2016; Kaminski et al., 2008; Teepe et al., 2016). Because AL and TL stimulate both the quantity and quality of linguistic input and the active verbal participation of the child, this effect was expected in both receptive and on productive vocabulary development.

Regarding the second question, we hypothesized two possible patterns. The first of these is that there would be an interaction of program with the child's functioning and family contextual factors, with children at-risk profiting more from the program. Alternatively, there would be no interaction of program with the child's functioning and family contextual factors, with AL and TL being similarly effective for all children. These hypotheses are based on the relatively few studies on the differential effects of early intervention programs, because these studies seem inconclusive about who benefits most of family literacy programs (Burger, 2010; Reynolds, 2004; Van Steensel et al., 2011). In general, these studies show that programs are equally effective for at-risk families and non-at-risk families, with some programs being slightly more effective for at-risk families.

Method

Participants

The present study is part of Parents in Preschool Education in the Netherlands (see also Teepe et al., 2017). Dutch preschool organizations were approached to participate along with their preschools. Preschools were included if they met all Dutch policy quality standards for preschool education (i.e., a maximum class size of 16 children, child-to-teacher ratio of 16:2, a qualified center-based program and preschool teachers who have received specialized center-based training). Moreover, preschools were only included if the teachers had no prior professional experience with a family literacy program. Thirteen preschools (two to six per preschool organization) met the inclusion criteria and were willing to participate.

Because of policy constraints, we used a controlled quasi-experimental design to allocate preschools to the AL, TL or control condition. Four preschools were required by their local policy to start with a family literacy program that particular school year and were randomly assigned to AL or TL. The remaining nine preschools were randomly assigned to one of three conditions. This

resulted in four AL preschools (n = 72 children at the start of the project), four TL preschools (n = 73) and five preschools participating as a control group (n = 78). Each participating preschool had, on average, 17 parent-child dyads, ranging from eight to 30 dyads.

Preschool teachers recruited families via a brochure and introductory meeting. The age inclusion range for the children was 30-39 months (2.6-3.3 years of age), following program guidelines and taking into account that children older than 39 months would enter formal schooling before the end of the study. A total of 223 preschool children (M_{age} = 35.4 months, SD = 3.5 months) started the study, of whom 43.5% (n = 97) were girls. Following the standard procedure in Dutch preschool education, all children attended the preschool two to four half-days (6 to 12 hours) per week.

Children came from linguistically diverse backgrounds. In 108 families (48.4%) only Dutch was spoken at home with these children learning Dutch as a first language (L1). In the other families (n = 115) either a combination of Dutch with other language(s) or only other language(s) were spoken at home (with a total of 48 different languages including Moroccan, Turkish, Polish, Farsi or Papiamento). These children learned Dutch as a second language (L2). The ratio of L1/L2 children within preschools varied from 20.0% to 94.4% L2 children. Of 223 participating parents, 86.1% were mothers. The highest education level of the mother was used as a measure for educational level, based on maternal education being the most robust sociodemographic predictor of child development (Bornstein, Hahn, Suwalsky, & Haynes, 2003). Educational level was measured on a six-point-scale ranging from no education (1) to university (6) and showed a mean of 4.4 (SD = 1.2). There was a broad range because for one preschool (n = 18 children), the percentage of lower educated mothers (e.g., ≤ 2) was fairly high (33.3%), whereas for three other preschools (n = 18 to 25 children) the percentage of higher educated mothers (e.g., ≥ 5) was high (60% to 76.2%). In the analysis, linguistic diversity and mother's educational level were included as covariates.

The study involved 46 female preschool teachers with two to four teachers per preschool. The high ratio of teachers to preschools (N = 13) is due to governmental guidelines stipulating a 16:2 child-to-teacher ratio as well as to most teachers working part-time. Teachers' ages ranged from 27 to 60 (M = 47.38, SD = 7.95 years). 37 teachers had completed vocational education (80.4%), eight higher professional education (17.4%) and one university education (2.2%). All teachers were experienced professionals with over five years of work experience. Characteristics of the sample are presented in the results section after taking attrition into account.

Intervention

The family literacy program used in the current study was the Dutch program 'Early Education at Home' (in Dutch: *VVE Thuis*, developed by the Dutch Youth Institute, 2014). The key element of the program was to improve linguistic input quality and sensitive responsiveness. To achieve this, the program classified theoretical elements of input quality and sensitive responsiveness (Ainsworth et al., 1978; Hoff, 2003a) into five general guidelines for parent-child interaction. These guidelines were 1) involve your child in conversations, 2) encourage your child, 3) provide rules and structure, 4) recognize your child's needs, and 5) provide autonomy. The general guidelines were used to provide practical examples of specific interaction behavior during the parent meetings. Every six weeks parents received a workbook with eight activities to be conducted at home (i.e., shared reading, storytelling activities, memory games, puzzles, songs and rhymes, arts and craft activities, and daily activities). During 1.5-hour parent group meetings, parents were trained on interaction behavior to be performed during these activities. Parent groups consisted of, on average, 12 parents (ranging from 6 to 25 parents, with the larger groups being divided into subgroups during the meeting) to allow active intra-group interactions. The program was aligned with the preschool program, with the same four six-weekly themes and content offered at the same time.

Active learning during group meetings (AL)

Teachers were familiarized with the family literacy program, including AL, via an information session (2 hours), a training session (4 hours) and two 1-hour coaching sessions after the first two parent meetings (all provided by the first author). The focus of the AL training and coaching was on active learning activities to be conducted with parents. We trained teachers how to model, practice and interactively discuss the activities and proposed interaction behavior. During the training, teachers evaluated video examples of parent-child interactions, practiced modeling activities (for example shared reading), and conducted interactive discussions about program materials and interaction behavior. In addition, teachers were told how to create a safe and active learning environment for parents. In the coaching sessions, the first author provided feedback on the active learning activities used by the teacher during the parent group meeting.

In the parent group meetings, teachers were requested to start by evaluating the preschool and family literacy program activities from the preceding theme. They had to interactively discuss how activities had been conducted, what parents had learned from them and what difficulties they had experienced. The focus of this

evaluation was on parents' ability to apply the five general interaction guidelines at home. We suggested that teachers then introduced the new theme. They were asked to go through all the activities of the programs' workbook by using modeling techniques, role play, conducting activities together and interactively discussing activities. Again, teachers were asked to focus on parents' interaction behavior during these activities. In addition, we invited teachers to show concrete preschool materials (books, toys and games) and use these to explain parallels between the preschool and family literacy program.

Technology-enhanced learning (TL)

TL teachers were, as with AL teachers, familiarized with the family literacy program and TL via an information session (2 hours), a training session (4 hours) and two 1-hour coaching sessions after the first two parent meetings. The focus of the TL training and coaching was to make teachers familiar with the tablet computer and the technology-enhanced storytelling activity Jeffy's Journey. Jeffy's Journey was a digitized version of one of the program activities. It involved shared verbal storytelling supported by a story structure and real-time visual, auditory and textual prompts (Teepe, Molenaar, & Verhoeven, 2016). It consisted of four storytelling phases that guided parent and child through creating a meaningful story together. For each character in the story, they could select visual, auditory and textual storytelling prompts, such as emotion changes and open-ended questions. Digital instruction was also available using screenshots of the activity and audio instruction. We trained teachers how to conduct technology-enhanced storytelling, how to explain the concept to parents and how to facilitate transfer of the interaction behavior to other program activities. During the training, teachers were told about the functions of the tablet computer, practiced technology-enhanced storytelling, and conducted an interactive discussion on interaction behavior during technology-enhanced storytelling. During the coaching sessions, the first author provided feedback on the delivery of technology-enhanced storytelling by the teacher during the parent group meeting.

In the parent groups meetings, teachers were instructed to first evaluate the preschool and family literacy program activities from the preceding theme. They had to interactively discuss how technology-enhanced storytelling and program activities had been conducted, what parents had learned from it and what difficulties they had experienced. We advised teachers to focus on parents' ability to apply interaction behavior during technology-enhanced storytelling and the transfer of this behavior to other program activities. Next, teachers

were asked to introduce the new theme. They introduced the technology-enhanced storytelling activity and had to discuss with parents how to use the same interaction behavior during other program activities, such as craft activities or traditional shared book reading. In addition, we asked teachers to show concrete preschool materials (books, toys and games) to explain parallels between the preschool and family literacy program. TL parents received a tablet computer (on loan) pre-loaded with Jeffy's Journey.

Treatment fidelity

To ensure the two groups of AL and TL teachers provided the same instruction during parent meetings they were provided with a manual containing a protocol explaining step-by-step what to address during each parent meeting and how to do it. In addition, three measures were used to assure treatment fidelity. First, preschool teachers registered parents' attendance at the four parent meetings. Parents who were not able to attend the meeting and instead received individual instruction were counted as present. Second, participating parents were asked to record their program activities in a diary, with one diary per program theme. Diaries were handed in at the end of each theme. The total number of diaries handed in was counted, ranging from 0 to 4. As a final measure of treatment fidelity, the number of program activities conducted within each theme was calculated from the diaries.

Measures

Vocabulary

Children's vocabulary development was assessed by means of theme-based receptive and productive vocabulary tasks. The curriculum-based vocabulary tasks were designed to assess vocabulary development within the four themes offered during the intervention period. From each of the four themes, each consisting of about 225 words to be offered to the children, 16 nouns were selected. These words were comparable in their frequency in the program materials and suited the target group according to a Dutch wordlist for preschool children (Bacchini, Boland, Hulsbeek, Pot, & Smits, 2005). These words were first assessed productively and then receptively.

In the productive task, children were shown a picture of the target word and simultaneously asked to complete a sentence in which the target word was left out (for example: The dog wags his ... [tail]?). For each correctly completed sentence, one point was assigned with a maximum of 16 points (Cronbach's α per theme ranged from .78 to .89). All responses other than the target word,

including responses in other languages, were assigned a zero score. The receptive task followed the format of the Peabody Picture Vocabulary Test in which children had to select the picture of the target word from among three distractors (perceptual, phonological and semantic). Each correctly selected item was assigned one point, with a maximum of 16 points (Cronbach's α per theme ranged from .76 to .83).

Background variables

Demographic information. Parents received a background questionnaire containing questions about their child (gender and date of birth) and about themselves (their educational level and language(s) spoken at home). Teachers also received a questionnaire with questions about their age, educational level and years of working experience.

Executive functioning (EF). In line with previous research into preschool children's EF (Wiebe, Sheffield, Nelson, Clark, Chevalier, & Espy, 2011; Weiland, Barata, & Yoshikawa, 2014), the EF concept was operationalized with multiple tasks measuring different dimensions that cluster into a unitary EF construct. Each task relied on a different but related EF component; a word repetition-string task measured working memory (Schlichting & Lutje Spelberg, 2010), the Hand Game (Hughes, 1996) measured response inhibition and the Dimension Change Card Sort measured attention shifting (DCCS, Zelazo, 2006). All tasks showed high internal consistency (Cronbach's α = .90, .81 and .73 respectively). Principal Component Analysis with Varimax Rotation showed one underlying factor with an eigenvalue > 1, explaining 42.6% of the total variance. Component loadings were .57 (working memory), .74 (response inhibition) and .64 (attention shifting). The composite score was calculated by adding up the *z*-score of the working memory task and the dichotomous scores of response inhibition and attention shifting. This was then divided by the number of tasks ((*z*-memory + response inhibition + attention shifting) / 3).

Social functioning (SF). Children's social functioning was measured by a subset of the Dutch KIJK! observation scale for preschool children (Van den Bosch & Duvekot-Bimmel, 2012), which was completed by preschool teachers. The observation scale consisted of fifteen statements about children's behavior with respect to their peers and teachers (for example, 'the child is able to share with other children'). Items were scored on a 3-point-scale of 'not true, 'partly true' and 'entirely true'. Internal consistency was high (Cronbach's α = .90). This is in line with the validated kindergarten version (Van den Bosch & De Jaeger, 2000). Calculations were conducted on the mean score.

Procedure

An overview of the study's procedure is shown in Figure 5.1. The study took place from August 2014 to May 2015. In August, all teachers took part in an information session. At start of the school year, in September 2014, AL and TL teachers received their training, and information sessions for parents (AL, TL and control) and were shown how to inform the parents about the study and to ask them to participate. Before the start of the study, teachers gave active consent for their participation as did parents for their child's and their own participation.

The first measurement was performed in September 2014, when the majority of children had just entered preschool. Vocabulary of the first theme and EF tasks were administered in two separate sessions. Children were individually tested in a quiet place outside the classroom. They were tested by eight trained test-assistants who followed strict testing protocols. At the time of testing, parents and teachers completed the questionnaires. Over the course of the school year, all children (AL, TL and control) participated in the same four six-weekly themes of the preschool program: Me and my family, Winter, Clothes and Spring. At the same time, AL and TL children and their parents were involved in the same four themes at home via the family literacy program. Before and after each theme, vocabulary of that theme was pre- and post-tested. The study was approved by the Ethics Committee for Behavioural Research of Radboud University (dossier: ECG2013-0606-116).

Analyses

Of 223 cases, 85 were incomplete because of missing values on one or more of the vocabulary tests, the EF task or the SF questionnaire. Demographic data on the child (age, gender) and parent (educational level mother, linguistic diversity) was complete. To prevent information loss, missing data within vocabulary tests and the SF questionnaire was imputed at item level using Expected Maximization in SPSS 22 (IBM corps, 2013). Missing data on entire tests or questionnaires was not imputed. As a result, 3 of 85 cases (3.5%) with missing values were able to be included in the analysis, resulting in a total of 141 cases. Of these children, 42 were in the AL condition, 47 in the TL condition and 52 in the control condition at the end of the study (see Figure 5.1 for attrition over the schoolyear).

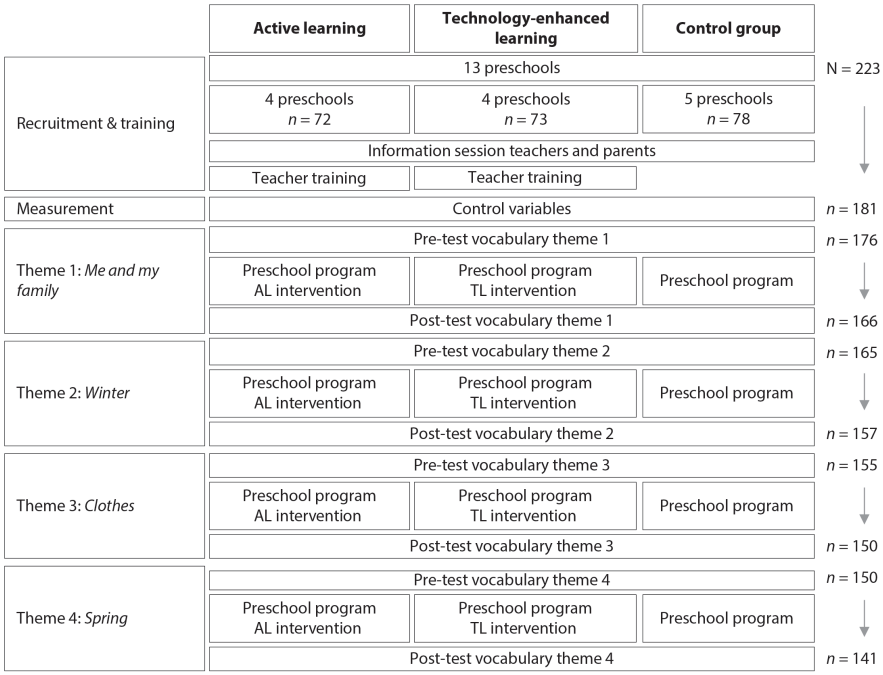
Preliminary analyses for repeated measures ANCOVA ensured no violation of the assumptions of normality and homogeneity of variance. Mauchly's test indicated that the assumption of sphericity had been violated for the receptive

vocabulary within-subjects factor theme ($\chi^2(5) = 13.793$, $p = .017$, $\varepsilon = .931$), and the productive vocabulary within-subjects factors theme ($\chi^2(5) = 14.152$, $p = .015$, $\varepsilon = .932$) and theme*time ($\chi^2(5) = 31.327$, $p < .001$, $\varepsilon = .870$) and, therefore, Huynh-Feldt correction was applied.

Despite the nested nature of the data (children within preschools), preliminary analyses showed that the data did not have a multi-level structure. Intra-class correlations of the vocabulary tasks were low (mean $\rho = .05$) and models with both a child and preschool level did not have a significantly better fit than models with only a child level. Therefore, one-level repeated measures analyses were conducted in SPSS 22 (IBM corp, 2013).

Figure 5.1

Study overview with timeline for AL, TL and control condition



To answer our research questions, a 2 (time: pre, post) x 4 (theme: 1, 2, 3, 4) by 3 (condition: Al, TL, control) repeated measures MANCOVA was conducted with time and theme as within-subjects factors, condition as between-subjects factor and age, gender, EF, SF, education mother and linguistic diversity as covariates. The impact of treatment fidelity on receptive and productive vocabulary development of each theme was analyzed by means of a 2 (time: pre, post) x 2 (condition: AL, TL) x 2 (parent meeting: attended, not attended) x 2 (diary: handed in, not handed in) repeated measures MANCOVA with time as within-subjects factor; condition, parent meetings and diaries as between-subjects factors; and age, gender, EF, SF, education mother and linguistic diversity as covariates. Because of the low return rate of the diaries, the number of home activities, as reported by the parents, was not included.

Results

Descriptive statistics

Descriptive statistics of the vocabulary pre- and post-test scores and the covariates are presented in Table 5.1. A preliminary analysis of the vocabulary pre-tests and covariates showed that children from different conditions did not significantly differ on vocabulary pre-test scores or on other covariates, except for age. Children in the AL condition were slightly older than children in the control condition and TL condition ($F(2, 222) = 3.972$, $p = .020$): these variables have been included as covariates in the analyses. Bivariate correlations (Appendix D) indicated that all vocabulary tasks were strongly associated ($r = .33$ to $.83$, $p < .01$). Moreover, the covariates age, EF, SF and linguistic diversity were associated with the vocabulary tasks ($r = .20$ to $.61$, $p < .01$).

Table 5.1

Means and standard deviations on vocabulary tasks and control variables for the AL, TL and control condition (*n* = 141)

			AL (*n* = 42)		TL (*n* = 47)		Control (*n* = 52)	
			Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Vocabulary								
Theme 1: Me and my family	Receptive	pre	7.69	4.11	7.61	3.63	8.53	3.52
	Receptive	post	9.34	4.12	9.78	3.50	9.39	3.93
	Productive	pre	4.82	3.62	3.93	3.20	4.52	3.60
	Productive	post	6.60	4.32	6.74	3.64	7.19	4.23
Theme 2: Winter	Receptive	pre	9.90	3.55	9.01	3.63	9.49	3.52
	Receptive	post	11.67	3.55	11.35	3.14	11.14	3.14
	Productive	pre	6.58	4.65	6.49	4.38	7.01	4.33
	Productive	post	9.15	4.74	9.35	4.47	9.86	4.32
Theme 3: Clothes	Receptive	pre	8.73	3.80	9.23	3.56	9.01	3.28
	Receptive	post	10.31	3.18	10.18	3.32	10.19	3.55
	Productive	pre	6.49	2.84	6.02	3.34	7.40	3.05
	Productive	post	7.59	3.12	7.93	3.09	8.89	3.37
Theme 4: Spring	Receptive	pre	11.34	3.72	11.06	3.17	10.96	3.41
	Receptive	post	12.68	3.15	12.19	3.37	11.46	3.68
	Productive	pre	7.86	3.36	7.63	3.16	7.40	3.05
	Productive	post	9.68	4.19	9.54	3.43	8.89	3.37
Background variables								
Child age			36.87	2.94	35.54	3.37	35.50	3.06
Child gender (boys)			61.1%		45.8%		59.1%	
Executive functioning			0.10	0.37	.020	0.37	0.12	0.43
Social functioning			2.24	0.48	2.14	0.43	2.32	0.42
Linguistic diversity (L2)			50.0%		54.2%		42.4%	
Education mother			4.61	1.09	4.19	1.18	4.38	1.02

Treatment fidelity was analyzed for the experimental groups only. Descriptive statistics for attendance at the parent meetings, diaries handed in and activities conducted per theme are presented in Table 5.2. Attendance at the parent meetings and the number of diaries handed in, in both conditions decreased over the school year. A chi-square test showed that TL parents overall visited more parent meetings than AL parents ($\chi^2(4) = 17.293$, $p = .002$). There were no differences across the two conditions in the number of diaries handed in ($\chi^2(4) = 4.864$, $p = .302$). Overall, 34.3% of the parents in the experimental groups ($n = 49$) handed in all four diaries. The number of activities decreased over the

school year ($F(3, 141) = 4.528$, $p = .005$, $\eta_p^2 = .088$). There was no difference between AL and TL parents in the number of activities conducted ($F(1, 47) = 3.226$, $p = .079$, $\eta_p^2 = .064$). There was no significant interaction between time, parent meetings and diaries for any of the themes. Hence, variation in program implementation did not moderate program effects.

Table 5.2
Overview of AL and TL program implementation during the school year

	AL			TL		
	n	**%**		***n***	**%**	
Parent meetings						
Theme 1: Me and my family	72	76.4		73	86.3	
Theme 2: Winter	72	62.5		73	79.5	
Theme 3: Clothes	72	51.4		73	84.9	
Theme 4: Spring	72	47.2		73	63.0	
Diaries handed in						
Theme 1: Me and my family	72	65.3		73	68.5	
Theme 2: Winter	72	63.9		73	63.0	
Theme 3: Clothes	72	61.1		73	61.6	
Theme 4: Spring	72	51.4		73	52.1	
Activities conducted		*Mean*	*SD*		*Mean*	*SD*
Theme 1: Me and my family	47	14.64	9.63	50	12.58	6.03
Theme 2: Winter	46	12.89	7.63	46	10.24	8.30
Theme 3: Clothes	44	10.07	5.13	45	9.60	4.57
Theme 4: Spring	37	9.86	4.73	38	11.66	5.84

What is the effect of AL and TL on curriculum-based receptive and productive vocabulary?

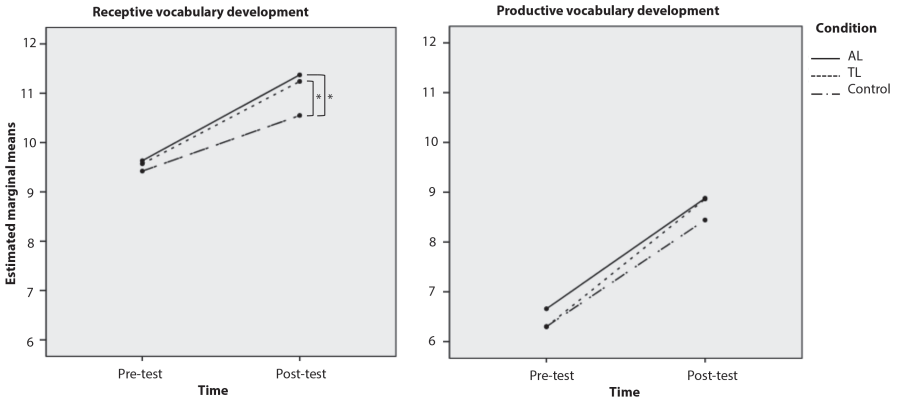
For receptive vocabulary, there was a significant interaction between time and condition ($F(2, 135) = 3.228$, $p = .043$, $\eta_p^2 = .046$). As Figure 5.2 shows, children in the AL and TL conditions made larger receptive vocabulary gains than control children. Within each theme, AL and TL children acquired approximately two of the 16 selected words receptively, whereas control children learned one. There was no main effect of time after controlling for the covariates ($F(1, 135) = .651$, $p = .421$, $\eta_p^2 = .005$). This indicates that the vocabulary gain for the whole sample within each theme was relatively small. There was a main effect of theme ($F(3, 405) = 6.755$, $p < .001$, $\eta_p^2 = .048$), with pair-wise comparisons showing

that the grand mean vocabulary scores of all four themes differed from each other. Despite these theme differences, there was no interaction between time and theme ($F(3, 405) = 1.936$, $p = .123$, $\eta_p^2 = .014$). There were no significant differences between the four themes for receptive vocabulary growth.

For productive vocabulary, there was no interaction between time and condition ($F(2, 142) = 1.698$, $p = .187$, $\eta_p^2 = .023$), indicating that there was no effect of condition for productive vocabulary development. Per theme, all children learned approximately two of the 16 selected words productively. There was also no main effect of time after controlling for the covariates ($F(1, 142) = 1.596$, $p = .208$, $\eta_p^2 = .011$). Like the receptive vocabulary gain, the productive vocabulary gain for the whole sample within each theme was relatively small. There was a main effect of theme ($F(3, 426) = 3.179$, $p = .024$, $\eta_p^2 = .022$). Pairwise comparisons demonstrated that the grand mean productive vocabulary scores of the four themes all differed from each other. Nevertheless, productive vocabulary growth did not differ per theme as there was no interaction between time and theme ($F(2.812, 399.290) = 1.222$, $p = .301$, $\eta_p^2 = .009$).

Figure 5.2

Receptive and productive vocabulary development for AL, TL and control conditions



Covariates appearing in the model are evaluated at the following values: child age = 35.60, child gender = .43, EF = .0919, SF = 2.2009, mother education = 4.33, linguistic diversity = .4722

Covariates appearing in the model are evaluated at the following values: child age = 35,66, child gender = ,46, EF = .1036, SF = 2.2148, mother education = 4.36, linguistic diversity = .4901

Do program effects differ depending on a child's social and executive functioning and family context?

For receptive vocabulary, there were no significant interactions between time, condition and any of the covariates, indicating that condition effects on receptive vocabulary were the same for all children. There were main effects of gender ($F(1, 135) = 4.583$, $p = .034$, $\eta_p^2 = .033$), EF ($F(3, 135) = 13.324$, $p < .001$, $\eta_p^2 = .090$), SF ($F(3, 135) = 19.597$, $p < .001$, $\eta_p^2 = .127$), education of the mother ($F(3, 135) = 9.529$, $p = .002$, $\eta_p^2 = .066$) and linguistic diversity ($F(3, 135) = 22.432$, $p < .001$, $\eta_p^2 = .142$). Girls, children with larger EF and SF, children from higher educated mothers and children learning Dutch as their first language had higher receptive vocabulary scores. The interaction between time and gender ($F(1, 135) = 4.808$, $p = .030$, $\eta_p^2 = .034$) showed that girls made larger receptive vocabulary gains than boys. Per theme, boys learned approximately one of the 16 selected words receptively, whereas girls learned 2 words. There was also an interaction between time and linguistic diversity ($F(1, 135) = 6.819$, $p = .010$, $\eta_p^2 = .019$), with L2 children showing larger receptive vocabulary gains than their L1 peers. Per theme, L2 children learned approximately two of the 16 selected words, whereas L1 children learned approximately one word.

For productive vocabulary, there were no significant interactions between time, condition and any of the covariates. Thus, program effects were the same for all children. Main effects of the covariates EF ($F(1, 142) = 16.888$, $p < .001$, $\eta_p^2 = .106$), SF ($F(1, 142) = 28.520$, $p < .001$, $\eta_p^2 = .167$) and linguistic diversity ($F(1, 142) = 51.714$, $p < .001$, $\eta_p^2 = .267$) were found. Children with larger EF and SF skills and children learning Dutch as a first language overall had higher productive vocabulary scores. There was an interaction between time and SF ($F(1, 142) = 3.937$, $p = .049$, $\eta_p^2 = .027$), indicating that children with higher SF made lager productive vocabulary gains. There also was an interaction between time and linguistic diversity ($F(1, 142) = 4.269$, $p = .041$, $\eta_p^2 = .029$), showing that L2 children made larger productive vocabulary gains (about three words) than their L1 peers (approximately two words).

Discussion

This study aimed to investigate effects of a family literacy program with active learning activities (AL) and technology-enhanced learning (TL) on preschoolers' curriculum-based receptive and productive vocabulary development. As well as analyzing overall effects we investigated whether program effects differed depending on the child's executive and social functioning and the family context. Using curriculum-based vocabulary tasks several times during the intervention period, we aimed at drawing robust conclusions about how

children respond to the interventions, resulting in important recommendations for program developers, teachers and policy makers. Answering our first research question, our study revealed a positive overall effect of AL and TL on curriculum-based receptive vocabulary development. As expected, children in both AL and TL conditions outperformed children from the control group. For productive vocabulary, no experimental effect was found. Children in the AL, TL and control group showed similar productive vocabulary development. Answering our second research question, we found no differential effects of AL and TL for children from different family backgrounds (i.e., linguistic diversity and educational level) or for children with higher or lower EF and SF. It can be concluded that effects of AL and TL were similar across children.

The curriculum-based vocabulary tasks allow us to draw these conclusions because they demonstrated a direct relationship between the intervention and the child's development. As Deno (1985) previously showed, repeatedly measuring children's vocabulary during the schoolyear provides a detailed reflection of children's abilities within the program. The curriculum-based vocabulary tasks offer important insights for practice. For program developers, the results show that themes vary in their difficulty; grand mean scores and gains within some themes are larger than in others. Program developers should consider whether these differences are desirable or not. For example, themes can increase their difficulty over the course of the school year, as children become older and increase their vocabularies. Moreover, program developers should reconsider the selection of words because results show that at pre-test children already know half or even two-third of the words presented. Formulating linguistic criteria or the use of word frequency lists may improve the word selection process.

For preschool teachers, theme differences are also important to take into account, to adapt the intensity of their instruction to the difficulty of the theme. Another important point resulting from the curriculum-based tasks is the large difference that exists between receptive and productive vocabulary development. The effect on receptive vocabulary but not on productive vocabulary development indicates that extra investment is required. Teachers could pay even more attention to the training of parents, by focusing more on how parents can stimulate their child to use new vocabulary.

Our results underscore the importance of examining alternative approaches to improve the impact of family literacy programs. First of all, stimulating parent's interaction skills via AL and TL is an effective way to enhance children's receptive vocabulary development. The results of this study suggest that involving parents

in active learning activities, such as modeling, interactive discussions and opportunities to practice certain interaction behavior, may have helped them to improve their interaction skills, which then resulted in a positive change in their children's receptive vocabulary.

Technology-enhanced learning activities, in which parents were provided real-time interaction support, seemed to have had a similar effect on parents' interaction skills and children's vocabulary development. Previous studies showed that programs focusing on parents are less likely to have positive effects compared to programs directly focusing on children's vocabulary development (Blok et al., 2005). The current results are important because they demonstrate that, via indirect approaches that target parents, vocabulary changes in the child can be achieved. To establish positive effects on children's vocabulary, a systematic change in parent's interaction behavior is required. Parent group meetings including AL and TL apparently facilitated these changes in parents' interaction behavior with their children at home during literacy activities.

The positive changes in children's receptive vocabulary via AL and TL, are consistent with those of previous studies that showed improvement in receptive vocabulary after training parents with active learning and technology-enhanced activities. In their meta-analysis, Grindal and colleagues (2016) found suggestive evidence that systematically modeling and practicing interaction behavior with parents was associated with effects on children's pre-academic knowledge (such as reading and letter recognition). The positive effect of AL in our study provides support for this suggestive evidence. With respect to TL, previous research (Gremmen et al., 2016; Teepe et al., 2016) found that technology-enhanced storytelling, where parents received real-time interaction support, fostered parent-child interaction quality and children's vocabulary development. However, these studies involved artificial learning contexts in which parent training was provided by researchers rather than teachers. The current study shows that, within the complex home setting of a naturalistic educational situation, TL may also work. It can be concluded that both AL and TL are effective for stimulating children's receptive vocabulary development.

We found no positive effects of AL and TL on children's productive vocabulary development. A first explanation for this is based on the assumption that vocabulary exists in a continuum, in which receptive vocabulary is seen as a precursor for productive vocabulary (Nagy & Scott, 2000). We propose that children have acquired an understanding of the words' meanings, but that they were not yet able to actively use it and apply it in the appropriate context. It could be that effects on productive vocabulary occur at a later moment in time.

Another explanation for this finding is related to how AL and TL affected parents' interaction behavior. In both approaches parents were trained to provide linguistic input and to involve their child in verbal interactions at home. The effect on children's receptive vocabulary indicates that parents indeed provided sufficient linguistic input for their child to encode linguistic input, match phonological representations to referents and store the links in their working memory (Sénéchal, Thomas, & Monker, 1995). However, for productive vocabulary development to occur, the child also needs to be offered opportunities to retrieve words from their working memory, by practicing and being verbally active in social interactions. In spite of parents' efforts to interact more with their child, we hypothesize that both variants of the program may have supported parents insufficiently to activate their child's verbal interactions. Parents may have been too dominant in conversations with their child, leaving too few opportunities for children to retrieve words from their working memory and to use them during interactions.

This idea is supported by previous research showing that parents tend to be the dominant speaker when interacting with their child (Hoff, 2006; Teepe et al., 2016). Even though the program supported parents in improving their interaction behavior, the program should train parents more intensively to leave more room for their child to verbally participate in the interaction, by, for example, further stimulating the use of open-ended questions. The current result, a positive effect on receptive vocabulary but no effect on productive vocabulary, indicates that children involved in AL and TL have received sufficient linguistic input to develop their receptive vocabulary, but have been offered insufficient opportunities to produce output for developing their productive vocabulary.

It should be acknowledged that the positive effect of AL and TL on children's receptive vocabulary development is limited. Experimental children learned on average two of the selected 16 words per theme (12%) compared to control children who learned one word (6%). However, considering that, on average, nine of the 16 words were already known at pre-test, the learning gain is larger. It might be more appropriate to say that two words (experimental children) and one word (control children) out of seven unknown words were acquired within six program weeks. That way, experimental children expanded their vocabulary by 29% compared to control children expanding their vocabularies by 14%. In the light of the total number of words offered within each theme (about 225 words per theme), this could mean that, per theme, experimental children learned about 65 words whereas control children might have learned approximately 32 words in six weeks. It is expected that the vocabulary growth

would also continue exponentially, because the more words that children know, the quicker they can learn new ones (Nagy & Scott, 2002).

We believe that both variants of the program have the potential to enhance children's vocabulary to an even larger extent. Treatment fidelity data demonstrate that implementation of the interventions was adequate, but that in both conditions parents' involvement varied and decreased over the school year. Implementation can be improved by more intensive guidance of parents, or increasing the need for parents to visit the meeting. TL parents visited more parent meetings, suggesting that the digital component resulted in a need for instruction. In addition to implementation, other challenges might have impeded the success of the programs. There were many steps to take in order to establish vocabulary effects; first researchers trained teachers, then teachers trained parents and finally parents conducted the program at home to foster their child's vocabulary. For such a stepwise process with many different people involved to be successful, a precise routine is required. The four parent meetings might have been too limited to implement this process optimally. Moreover, with regard to the TL condition, unforeseen technical issues were faced, such as insufficient wifi-connections, teachers and parents with limited digital experience, and the technology-enhanced storytelling activity giving errors. AL and TL were effective for children's receptive vocabulary development despite these practical challenges, but there is still room for improvement in the implementation of the program.

With respect to the second research question, no differential effects of AL and TL were found. AL and TL did not interact with family contextual factors or the child's executive or social functioning. This is consistent with the results of the systematic review of Burger (2010) and the meta-analysis of Van Steensel and colleagues (2011), which both demonstrated that children benefit equally from early interventions, regardless of their family background or their own capacities. Our study contributes to these findings. Our alternative AL and TL approaches fit the needs of different kind of families (higher and lower educated, L1 and L2) and children (with lesser and greater executive and social functioning). However, they do not have the potential to compensate for differences between children related to the family context or the child's executive or social functioning. Although there were no differential effects of the intervention by family context and the child's functioning, results do emphasize the large impact these factors have on children's vocabulary. Girls, children with higher executive functioning and social functioning skills, and children from higher educated mothers and growing up in L1 families had larger vocabularies. Girls and L2 children showed

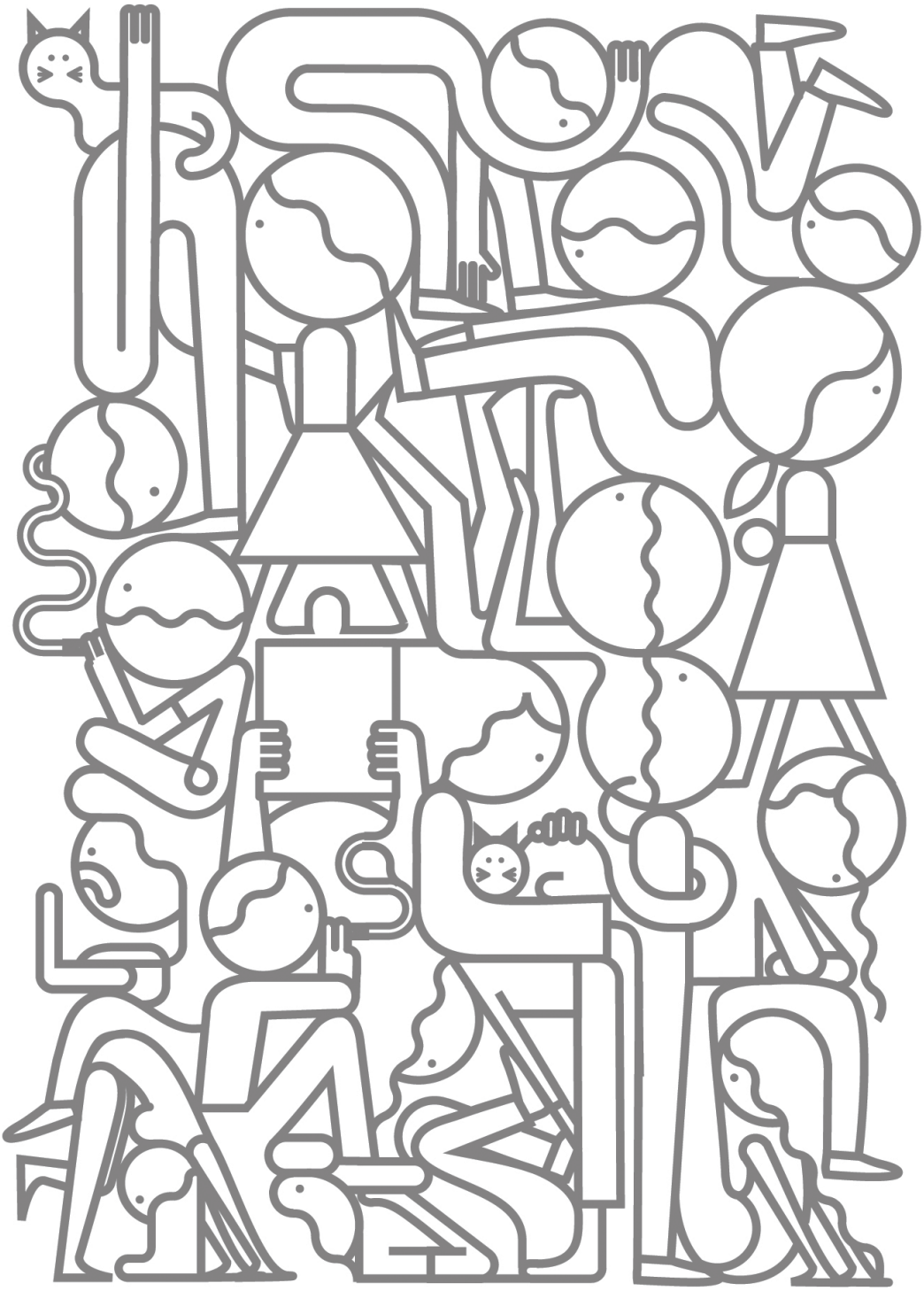
larger vocabulary growth, compared to boys and L1 peers. This indicates that L2 children have smaller initial vocabularies, but are able to catch up when entering preschool. These results confirm the large vocabulary differences that exist between children at preschool (Fenson et al., 1994; Teepe et al., 2016; Van Druten-Frietman et al., 2015).

For policy, our results indicate that it is of importance to invest in the home environment to increase the vocabulary of young children. In addition to providing education within the preschool, the center-based approach, policy makers should also consider investing in parents and the home environment in a combined approach. Even though the effects are small they are still meaningful. Because both variants of the family literacy program turned out to be effective, policy makers should carefully weigh the strengths and limitations of AL and TL mentioned above. Depending on their opinion of support, they could provide the program to all children, as the program proved to be effective for all children, regardless of background. However, if the goal of the government is to help children with smaller vocabularies offering the program to just those children with a smaller vocabulary could also be considered.

In spite of this study's strengths, some important limitations must be noted. First, because of policy constraints, we were not able to randomly assign preschools to conditions. This might have resulted in selection effects, even though no significant differences between conditions were found at pre-test. Second, we are aware that results largely depend on the words selected for the curriculum-based tasks. Per theme, we selected 16 nouns that, in our opinion, together reflected the content of that specific theme and were matched in difficulty based on word frequency lists. However, children might very well also have learned other words that were not present in our tests. Related to this, many children already showed high scores at pre-test, which would have reduced the potential of the test to show vocabulary growth. Third, the sample suffered from random attrition resulting in reduced statistical power.

Our findings point towards research opportunities for the future. The current study examined effects of AL and TL at child level. To gain better insight in the working mechanism of family literacy programs, future studies need to adopt measures demonstrating effects of family literacy programs on skills and perceptions of parents. Changes in the interaction behavior of parents and children need to be examined in a similar manner, for example by means of video-observations. Secondly, taking into account the later development of children's productive vocabulary, a productive retention test would demonstrate whether the interventions used here have an (delayed) effect

on productive vocabulary as well. In line with this, it should be investigated whether program effects increase when the intervention is offered for a longer period of time, and if receptive vocabulary effects are sustained. For now, we can conclude that AL and TL are both effective approaches for family support at home and that using curriculum-based tasks provides valuable insights for policy and practice.



Chapter 6

Discussion

The aim of the present dissertation was to further explain variation in preschool children's vocabulary, and to investigate whether alternative approaches to deliver a family literacy program have the potential to foster children's vocabulary development. Accordingly, the two following research questions were addressed:

1. How can the variation in preschool children's vocabulary be explained from the family context and the child's functioning?
2. Are active learning (AL) and technology-enhanced learning (TL) effective ways to deliver a family literacy program and foster children's vocabulary development?

The studies in Chapter 2 and 5 showed that, in addition to children's age, linguistic diversity at home and mother's education, their executive and social functioning play an important role in explaning variation in preschool vocabulary. These factors should therefore be taken into account when investigating vocabulary effects of family literacy programs. The studies reported in Chapter 3, 4 and 5 demonstrated that AL had a positive effect on both children's curriculum-based and general receptive vocabulary, whereas TL had a positive effect on curriculum-based receptive vocabulary. In the remainder of this chapter, the main findings of this dissertation will be further discussed. The chapter concludes with limitations, directions for future research and educational implications. This resulted in a revisited view on the delivery modes of family literacy programs.

Variation in preschoolers' vocabulary

Research typically addressed variation in preschool vocabulary from the biological (Bronfenbrenner & Morris, 1998) or the cognitive (Chomsky, 1965; Hoff, 2003a) approach, either focusing on the perspective of the family or the child. Limited attention has been paid to the integration of these two models, in which the family contextual factors (linguistic diversity, education of the mother, reading activities and parent self-effiacy), and child factors (executive and social functioning) are examined together. To answer the first research question, two studies were conducted. The studies in Chapter 2 and Chapter 5 demonstrated that children's initial receptive and productive vocabulary knowledge and its development over time was influenced by both family contextual factors (i.e., linguistic diversity and mother's educational level) and children's executive (EF) and social functioning (SF). Moreover, L2 children had smaller initial vocabularies, but showed larger vocabulary gains over the schoolyear, compared to their L1 peers.

The results in the first place confirmed previous research (Ebert et al., 2013; Hoff, 2006; Van Druten-Frietman et al., 2015) by showing the large impact of linguistic diversity and educational level of the mother. The impact of linguistic diversity and mother's educational level can be explained by their influence on the quantity and quality of linguistic input children are exposed to at home. Children growing up in linguistically divers home environments with a minority language spoken at home experience less input of a country's native language. Even though their first language helps them developing vocabulary in a second language (Cummins, 1979), at the preschool age, linguistically diverse children still have smaller vocabularies than their L1 peers. The fact that L2 children made larger vocabulary gains over the schoolyear indicates that they are able to catch up with their peers as soon as they enter preschool. When entering preschool, the language input and output in the country's native language increases through verbal interactions with teachers and peers, resulting in increased vocabulary development.

The impact of the educational level of the mother on children's vocabulary can be defined by the quantity and quality of verbal interaction in which higher and lower educated mothers engage their child. In general, lower educated parents have fewer language stimulating materials at home, they tend to engage their child in fewer interactions, and the linguistic input they provide is of lower quality and less adjusted to the child's needs (Hoff, 2006; Rowe, 2012; Van Kleeck, 2008). In contrast, higher educated parents tend to be more involved in the development of their child, engaging them more often in language stimulating activities and initiating high quality and sensitive responsive interactions. As a consequence, children being raised in higher educated families often have larger vocabularies compared to children growing up in lower educated families (Hoff, 2006). This was confirmed in the current studies.

The integration of the family context and children's executive and social functioning extended previous research by showing that, in addition to linguistic diversity and mother's education, children's EF and SF were very influential for preschool vocabulary. In previous research following cognitive approaches of vocabulary development, the importance of EF and SF for children's vocabulary was demonstrated (McClelland et al., 2000; Weiland et al., 2014), yet limited attention had been paid to the contributions of EF and SF to vocabulary within the broader context of the home environment. The current dissertation showed that, with strong predictors included in the model (i.e., linguistic diversity and mother's education), EF and SF turned out to be significant and robust predictors of children's vocabulary aswell. In line with previous research, children with better developed EF and SF had larger vocabularies. Regarding EF, this indicates that the

ability to regulate cognitive and behavioral processes is essential for children's vocabulary. With respect to children's SF, the ability to initiate, participate and maintain verbal interactions is vital.

It can thus be concluded that, on the one hand, vocabulary depends on the linguistic input provided to children in their home environment. On the other hand, it largely depends on how children process this linguistic input, both cognitively and socially. In addition to linguistic diversity and educational level of the mother, EF and SF have to be considered essential factors when explaining differences in preschool children's vocabularies. Variation in preschool vocabulary can be explained best by integrating an environmental and cognitive approach of vocabulary development. Both perspectives are important to take into account when investigating intervention programs that aim to support children's vocabulary development.

Effects of family literacy programs

To anticipate on vocabulary differences across children and to support parents in verbal interactions with their child, family literacy programs were implemented. The second research question concerned the effects of two alternative approaches to deliver a family literacy program on children's vocabulary development. Chapter 3, 4 and 5 reported on studies conducted to answer the second research question. An overview of the results presented in these chapters is provided in Table 6.1.

Table 6.1

Overview of vocabulary effects of active learning (AL) and technology-enhanced learning (TL) in the experiment and intervention study

	Experiment *Chapter 3*	**Intervention study** *Chapter 4* **and** *5*	
	TL[1]	**AL**	**TL**
Overall curriculum-based receptive vocabulary	o	+	o
Overall curriculum-based productive vocabulary	+	o	o
Thematical curriculum-based receptive vocabulary		+	+
Thematical curriculum-based productive vocabulary		o	o
General receptive vocabulary		+	o

+ positive effect, - negative effect, o no effect

[1] Technology-enhanced storytelling as activity on itself, not integrated in a family literacy program

Note Blanks indicate that the variable was not included in that chapter

The experiment with the newly developed technology-enhanced storytelling activity (Chapter 3) demonstrated that technology-enhanced storytelling had a positive effect on children's curriculum-based productive vocabulary development. No effects were evidenced on children's receptive vocabulary development. Moreover, technology-enhanced storytelling stimulated verbal involvement of the parent and child. Certain design principles (e.g., the use of storytelling prompts) were associated with high quality parent-child interaction.

Chapter 4 and 5 presented the outcomes of the one-year intervention study on the family literacy program with active learning (AL) and technology-enhanced learning (TL). In these chapters, the family and child characteristics were included in the models as covariates to control for vocabulary variation between children and provide clear program effects. Results of the evaluation at the end of the year (Chapter 4) showed that the family literacy program using AL was effective for stimulating children's overall receptive curriculum-based and receptive standardized vocabulary. This indicated that the program affected both vocabulary learned within the preschool curriculum as outside the preschool. The family literacy program including TL appeared to have no effect on children's vocabulary at the end of the year. Using the technology-enhanced storytelling activity as a way to deliver a family literacy program to parents, did not seem effective for children's vocabulary development after one year.

Chapter 5 further examined vocabulary effects of AL and TL. In this chapter, curriculum-based vocabulary tasks were assessed four times during the intervention period, to examine the direct relationship between the intervention and children's development. Positive overall effects of both AL and TL on curriculum-based receptive vocabulary development were found. Children in the AL and TL conditions outperformed children in the control group who were not involved in a family literacy program. Again, no effects were found on productive vocabulary development. Moreover, no differential effects of AL and TL were found for children from different family backgrounds (i.e, linguistic diversity and educational level) or for children with higher or lower EF and SF.

As summarized in Table 6.1, from these three chapters some overall conclusions can be drawn. First, the family literacy program with AL and with TL had a positive effect on children's receptive vocabulary development, yet, the effects on different outcome measures differed across conditions. AL had a positive effect on children's curriculum-based vocabulary measured at the end of the schoolyear and during the schoolyear, and on general receptive vocabulary. Positive effects of TL were only established on the thematical curriculum-based measures administered during the schoolyear. Second, AL and TL did

not affect children's curriculum-based productive vocabulary, even though the technology-enhanced storytelling activity itself promoted productive vocabulary. Finally, AL and TL were equally effective for particular groups of children. These main results are discussed in further detail.

First, it can be concluded that both ways to deliver a family literacy program were effective for children's receptive vocabulary development. Results in this dissertation add to the current literature on family literacy programs (Blok et al., 2005; Grindal et al., 2016; Kaminski et al., 2008; Van Steensel et al., 2011) that active learning activities to train parent's interaction behavior have a positive effect on their children's vocabulary development. Whereas previous research found suggestive evidence for including these type of activities in a family literacy program (Grindal et al., 2016; Kaminski et al., 2008), the one-year intervention study presented in Chapter 4 and 5 provided robust evidence. Positive effects were found on three different receptive vocabulary outcome measures that measured both receptive vocabulary development within the program and outside the program. Therefore, AL can be considered an efficient way to deliver a family literacy program to parents and children.

The delivery through technology-enhanced learning activities also promoted children's receptive vocabulary development, but only their curriculum-based vocabulary that was measured during the schoolyear. To our knowledge, in prior research, no digital activities were developed with the purpose to support parent-child interaction and enhance preschool vocabulary (Takacs et al., 2014, 2015) and as a consequence, they have never been examined as a way to deliver a family literacy program to parents. The current dissertation provides the first evidence that technology-enhanced learning to deliver a family literacy program was successful for children's curriculum-based receptive vocabulary development. Although no effects were found on all vocabulary measures, the studies show that involving parents in technology-enhanced learning does have the potential to produce changes in their children's vocabulary development. Effects of TL are, however, more subtile.

When comparing AL and TL, AL could be considered the stronger condition having more impact on children's receptive vocabulary development. Apparently, AL changed parent's interaction skills in such a way that it affected their children's vocabulary knowledge inside and outside the program's content. How could the differences between AL and TL be explained? In the first place, it could be that providing parents with real-time digital interaction support, which was quite a passive way of training interaction skills, did not facilicate a mental representation of the proposed behavior (Bandura, 1971) and thus insufficiently

stimulated parents to apply this behavior during other activities. The differences between the AL and TL condition might also be a matter of implementation. As discussed in Chapter 4 and 5, implementation of the TL condition faced some challenges. Both on the level of the preschool teachers as the parents it seemed that familiarization with the tablet computer and the technology-enhanced storytelling activity was not completely successful. Technological self-efficacy and transfer of the activity to parents during the group meetings are known to be essential (Voogt, Fisser, Pareja Roblin, Tondeur, & Braak, 2012), but this appeared to be suboptimal.

Moreover, successful transfer during the parent meetings was hampered by technological issues such as poor wifi connections and tablets giving errors. This may have impeded the implementation at home. Next to these implementation flaws, the technology-enhanced storytelling activity might have formed a too small part of the family literacy program. This activity was supposed to be a transfer activity that was used to train the proposed interaction behavior and, subsequently, to transfer this behavior to other program activities. Particulary for the transfer of interaction behavior, it might have been better to include more digital activities. Finally, the real-time support technology-enhanced storytelling activity itself could be more contingent to the actual interaction that was taking place.

The varying results on the different vocabulary tasks emphasize the importance of measuring effects of family literacy programs by both general and curriculum-based vocabulary tasks (Deno, 1985; Espin, Shin, Busch, 2005). The curriculum-based vocabulary tasks administered during the schoolyear showed a positive effect of TL, whereas the standardized test measuring general vocabulary and the curriculum-based tasks administered at the end of the schoolyear did not. The standardized test and the curriculum-bases test at the end of the year were not able to measure the fine-grained effect of this condition. This result underlines the importance of measuring effects also during an intervention.

Although positive effects of AL and TL were established on children's receptive vocabulary, they were not found on their productive development. A first explanation for this result could be that, because receptive vocabulary precedes productive knowledge, (Nagy & Scott, 2000; Sénéchal, Thomas, & Monker, 1995), effects on productive vocabulary occur at a later moment in time. Secondly, it is possible that AL and TL particularly trained parents in providing linguistic input to their child, which was reflected in the children's receptive vocabulary growth. For developing their productive vocabulary, children needed to be offered opportunities to retrieve words in their memory and produce linguistic

output (Nagy & Scott, 2000). It might be that the programs have insufficiently supported parents to activate linguistic output in their children. In Chapter 3, the experiment with technology-enhanced storytelling, an effect was evidenced on children's productive vocabulary. Moreover, the chapter shows that both parents and children were verbally active participants during the digital activity. This indicates that in the controlled setting of an experiment, technology-enhanced storytelling does have the potential to stimulate active child participation and influence productive development. In the intervention study, the technology-enhanced activity was part of a larger program including other activities and its usage was less controlled. The digital activity might have been too limited to foster children's productive vocabulary development.

The third main finding was that no differential effects of AL and TL were found. All children equally benefitted from the interventions, regardless of their family background or their own capacities. This is in line with results of previous research investigating differential effects of family literacy programs (Burger, 2010; Reynolds, 2004; Van Steensel et al., 2011). This dissertation added to the current literature that the same holds for a family literacy program delivered through AL and TL. The programs seemed to fit the needs of all families and children, however, they were not able to compensate for vocabulary differences between children that were related to the family context or a child's executive or social functioning skills.

One of the rationales to implement and study effects of AL and TL was to increase the small effects of family literacy programs found in previous studies (Van Steensel et al., 2011). Even though this dissertation shows that AL and TL are successful ways to deliver a family literacy program, it is important to mention that the effects of AL and TL are still relatively small and comparable in size with effects of previous research (Blok et al., 2005; Grindal et al., 2016; Kaminski et al., 2008; Van Steensel et al., 2011). To further increase the impact of family literacy programs, it could be considered combining effective program and delivery elements, such as active learning, technology-enhanced learning, home visits and delivery by professionals. However, one might also reconsider the expected impact of family literacy programs: Is it possible and realistic for family literacy programs to have a larger impact on children's vocabulary? Previous research also showed that interventions indirectly targeting children's development (i.e., via their parents) in general have smaller effects than programs directly targeting children (Blok et al., 2005). In this light, the current effects of family literacy programs found in this dissertation can still be called promising.

Limitations and future directions

Results of the present dissertation should be interpreted in the light of some limitations, that also provide opportunities for future research. In the first place, it should be acknowledged that internal validity may have been impeded by self-report measures (diaries, questionnaires on self-efficacy, reading activities, family contextual factors) and non-randomization of preschools to conditions. Unfortunately, policy constraints did not allow for random assignment of preschools to conditions. Moreover, during the schoolyear the sample of the intervention study suffered from random attrition and also in the experiment with technology-enhanced storytelling, the sample size decreased because of technological problems. This may have reduced statistical power.

In this thesis, we elaborated extensively on the effects of AL and TL on children's vocabulary development. However, less focus was on parental outcome measures. For example, data were obtained on the quantity and quality of parent-child interaction by video-observations four times during the intervention study. Previous research showed the importance of parent-child interaction for preschool vocabulary knowledge (Rowe, 2012; Van Kleeck, 2008). Therefore, future research should consider including the quantity and quality of parent-child interaction in their analyses, both as outcome variable for family literacy programs and as mediating variable to establish how programs affect vocabulary. In line with this, future research could unravel the development of parent-child interaction over time and whether its quantity and quality changes as a result of being involved in a family literacy program. What also needs to be further examined is whether the targeted behavior is only applied during program activities, or whether there is a transfer of the behavior to other activities outside the program. Finally, there is a need to investigate whether and how family literacy programs influence children's EF and SF because these abilities appeared to be important for vocabulary development (Wiebe et al., 2011; Vitiello & Williford, 2016).

With regard to the assessment of vocabulary, it should be acknowledged that in our study on the effect of family literacy programs, the results of the curriculum-based tasks were dependent on the selection of words. The relatively high scores on the pre-tests indicated that the vocabulary tasks may have been easy for the children. In addition, vocabulary retention tests could also provide insights in whether program effects are sustained and whether effects on productive vocabulary indeed occur at a later moment in time. Although it is outside the scope of the current dissertation, because of the large number of L2 children included in the studies, it would have been interesting to examine

vocabulary development of L2 children both in their L1 (minority language) and their L2 (Dutch). This could shed light on how the family literacy programs influence the child's first language and whether this facilitates acquisition of the second language.

There are some final remarks with regard to program characteristics and program implementation. In the first place, future studies including technology-enhanced activities should consider spending more time on training teachers and parents to get acquinted with the activity. Despite the central role of digital devices in current society (Labbo & Reinking, 2003), levels of familiarity with digital devices and activities differ across teachers and parents. Moreover, to increase the impact of the TL condition, combining different kinds of digital support could be considered. For example, York and Loeb (2014) showed that a text messaging program for parents increased the extent to which parents are engaged in home literacy. Therefore, combinations of different ways to provide technological support could be investigated.

Finally, in the current studies, the quality of the center-based program offered in the preschool and the role of the teacher in this were not taken into account. Previous research showed the importance of the interaction between the home and preschool program for creating the most optimal learning situation (Pinto, Pessanha, & Aguiar, 2013). Moreover, recent research showed that effects of Dutch preschool education are small (Fukkink, Jilink, & Oostdam, 2017). Therefore, it can be recommended that future studies focus on alignment of the preschool and family literacy program in relation to vocabulary effects.

Educational implications

The results of the current dissertation have implications for preschool teachers, program developers and policy. Preschool teachers are often very much aware of differences between children in their group. The current dissertation shows that teachers should consider that when children show limited understanding in vocabulary activities or do not understand verbal instructions, this may be caused by executive and social demands that are too high. Children differ in how they process linguistic input and also in the way they participate in social interactions. Teachers can adapt the educational content and their way of instruction to children's social and cognitive strengths and weaknesses, so that children can optimally learn from the educational content. This will help children developing their vocabulary so they can successfully start formal schooling after preschool.

Engaging parents in family literacy programs via their child's preschool appeared to be an effective way to foster children's vocabulary development. Preschool teachers play a crucial role in training parents and supporting them to conduct activities of the program at home. Therefore, it is important for preschool teachers to invest in the skills required to successfully implement a family literacy program. Most preschool teachers are used to teaching children and not so much to instructing groups of parents. Therefore, teachers could consider investing in their abilities to train and instruct parents, for example via additional schooling. Moreover, conducting successful parent meetings requires extensive organizational skills (i.e., planning meetings, ensuring wifi connections) and social skills (i.e., creating a safe atmosphere during parent meetings and good relationships with parents). It is important that teachers are aware of these requirements when implementing a family literacy program.

Program developers should also take into account differences between children's vocabulary sizes and what causes these differences. It appeared that many of the words offered in the programs were already known by children. The word selection process may be enhanced by using linguistic criteria or age appropriate word frequency lists. Moreover, as the programs did not affect children's productive vocabulary development, program developers could consider including more suggestions and activities for parents to verbally activate their child. Considering the positive associations found between technology-enhanced storytelling and parent-child interaction, digital activities could be a valuable option here. Moreover, as EF and SF were found important predictors of preschool vocabulary, developers could consider including activities with a focus on the development of children's executive and social functioning skills. In their teacher training, program developers should be aware of the high demands placed on preschool teachers in conducting a family literacy program. It is important to intensively prepare teachers for their role to train and support parents and address different abilities that are involved.

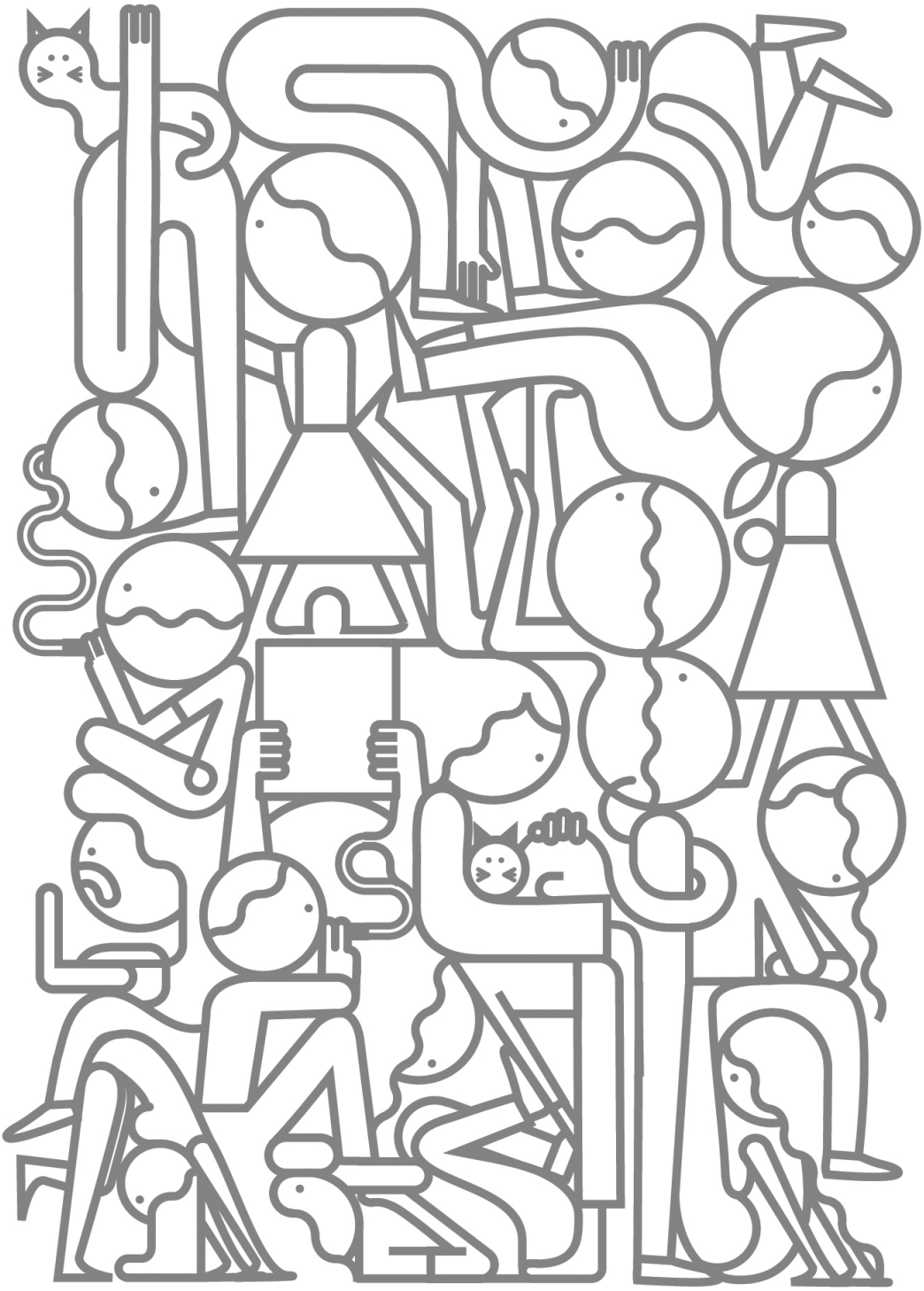
Because of the positive results for children's vocabulary development of both the AL and TL condition, the general advice to Dutch policy makers is to invest in family literacy programs. Involving parents in their child's development and improving their interaction skills has a positive effect on children's vocabulary development. Considering the importance of vocabulary for learning to read and write later on, involving families in family literacy programs during preschool may help children making a better start at formal schooling. However, policy makers should take into account the effort, challenges and investment involved when implementing this type of program, and also that effects might

be relatively small. Because both variants of the family literacy program were effective, policy makers should weigh the strengths and limitations of AL and TL discussed in the current dissertation. Considering the challenges faced in the TL condition and because AL turned out to be effective also on general vocabulary learned outside the preschool, for now, the most efficient way to support childrens vocabulary turns out to be AL. The programs appeared to be effective for all children, regardless of their background, and therefore it is advised to provide all families the opportunity to enhance their child's vocabulary through a family literacy program.

Delivery modes of a family literacy program revisited

To conclude, the present dissertation shows the importance of examining variation in preschool vocabulary and investigating alternative ways to deliver a family literacy program. The results show that the proposed theoretical model presented in Figure 1.1 (Chapter 1), is a useful model to approach and research this topic. The family context and the child's functioning indeed explained variation in children's vocabulary and were therefore considered to be important control variables to include in further analyses on program effects. Moreover, the proposed effects of AL and TL on children's vocabulary development were confirmed. The experiment in Chapter 3 provides support for the mechanism through which these effects were established: By improving the linguistic input and sensitivity of parents. Therefore, the model presented in Figure 1.1 can be considered valuable for investigating effects of family literacy programs in preschool children.

The conclusions in the current dissertation about variation in preschoolers' vocabulary and effects of family literacy programs could be established because of the deliberate study designs and methodological approaches that were applied. Large datasets, multilevel analyses to account for the nested structure of the data, the use of multiple vocabulary tests and the control of treatment integrity, contributed to the validity of the results found. This approach provides strong support for including active learning activities as a way to deliver family literacy programs to parents and indicates the potential of technology-enhanced learning. Even though the effect sizes were comparable with those found in previous studies this result is an important contribution. It is now shown that the delivery mode of a family literacy programs plays an important role in the effect that can be realized. Combining effective ways of delivering a family literacy program with other effective program or delivery characteristics will help increasing the impact of these programs in the future.



Appendices

Appendix A: supplementary material of Chapter 2

Appendix A1

Questionnaire: reading activities (English translation)

How often do you do the following activities?

1. Reading books, magazines, newspapers	Often	Sometimes	Never
2. Reading to your child(ren)	Often	Sometimes	Never
3. Telling stories to your child(ren)	Often	Sometimes	Never
4. Going to the library with your child(ren)	Often	Sometimes	Never

How often does your child do the following activities?

5. Reading books	Often	Sometimes	Never
6. Playing educational games (memory puzzles, dominoes)	Often	Sometimes	Never
7. Playing educational games on the computer/tablet/phone	Often	Sometimes	Never
8. Watching educational TV programs	Often	Sometimes	Never

Appendix A2

Questionnaire: parent self-efficacy (English translation)

Do you agree with the following statements?

1. I can help my child with learning new things	Yes	A little	No
2. I can motivate my child	Yes	A little	No
3. I know how to help my child with learning new things	Yes	A little	No
4. Sometimes I find it difficult to reach my child	Yes	A little	No
5. I am more influential for my child than the preschool teachers	Yes	A little	No
6. I cannot help my child with learning difficult things	Yes	A little	No
7. I am important for the development of my child	Yes	A little	No

Appendix B: supplementary material of Chapter 3

Coding Scheme for Coding Parent-Child Interaction Based on Van Kleeck et al. (1997)

Main Category	Definition	Examples of parent-child interaction	Technology-enhanced storytelling
Interaction-related	Utterances to support each other, give feedback or engage to complete the task.	P: very well, you already know a lot! C: yes! P: now we are telling a story, later you can play. C: ok.	Introduction story
Procedural-related	Utterances about functional aspects of the activity and tablet.	P: look, this is how you pick up Jeffy. C: I take Jeffy here. P: don't click on that button. C: click here?	Story creation
Story-related	Utterances about the content of the story.		
Contextualized	(1) Utterances about perceptually present entities, focussed on labelling, locating and noticing entities.	P: where do you see the polar bear? C: here! *points* P: the tablet said underware. C: underware. P: ohh, did you see that? C: ohhh!	Polar bear changes position Word prompt Swop prompt
	(2) Utterances about perceptually present entities, focussed on entities' characteristics and actions, recalling information and completing sentences.	P: and now the suitcase is …? C: empty. P: the bird takes the suitcase. C: yes, bird suitcase. P: how many monkeys do you see? C: one, two, three…four!	Introduction Introduction Question prompt

Main Category	Definition	Examples of parent-child interaction	Technology-enhanced storytelling
Decontextualized	(3) Utterances beyond perceptual presence, focused on summarizing story content, defining words, providing a point of view of a character, comparing similarities and differences, providing judgements about story content and associating different images.	P: you also have a nice suitcase. C: yes I have a new suitcase, blue. P: which animals did Jeffy visit so far? C: ehmm, the bird and the lion! P: he is looking angry, ggrrrr! C: I don't make him angry.	Looking in suitcase Question prompt Emotion prompt
	(4) Utterances beyond perceptual presence, focused on making predictions about story content, describing and solving a problem and explaining concepts.	P: what is the bird going to do? C: taking the suitcase. P: what can Jeffy do now he has al his clothes? C: sleep over at grandma's house! P: the suitcase is empty, it needs to be filled. C: yes, otherwise we cannot go camping.	Introduction Jeffy at last animal Looking in suitcase
Non-codable	Unintelligible utterances, filler words when they were the only word of a sentence	Hmmm, uhuh	
Non-response	Denials and refusals to participate	I don't know No	

Appendix C: supplementary material of Chapter 4

Bivariate correlations between study variables (*n* = 168)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
Vocabulary														
1. Receptive pre-test	1													
2. Receptive post-test	.60**	1												
3. Productive pre-test	.63**	.55**	1											
4. Productive post-test	.67**	.63**	.80**	1										
5. General pre-test	.71**	.61**	.70**	.74**	1									
6. General post-test	.64**	.71**	.64**	.74**	.67**	1								
Control variables														
7. Child age	.14	.18*	.22**	.16	.27**	.11	1							
8. Child gender[1]	-.13	-.22**	-.03	-.11	-.07	-.05	.02	1						
9. Executive functioning	.47**	.46**	.59**	.57**	.52**	.44**	.42**	.01	1					
10. Social functioning	.40**	.39**	.51**	.48**	.44**	.49**	.23**	.13	.44**	1				
11. Linguistic diversity[2]	.35**	.39**	.56**	.57**	.48**	.44**	.08	.05	.21**	.29**	1			
12. Education mother Treatment fidelity[3]	.11	.08	.10	.05	.13	.12	.01	-.12	.04	-.02	.05	1		
13. Diaries handed in	.04	.10	.05	.09	.04	.15	.10	-.01	.05	-.08	.04	.14	1	
14. Presence parent meetings	-.10	-.02	-.09	-.07	-.06	-.03	.08	.08	-.09	-.18*	.20*	.06	.70**	1

* $p < .05$, ** $p < .01$

[1] 0 = girl, 1 = boy,

[2] 0 = L2, 1 = L1,

[3] only computed for AL and TL conditions (*n* = 102)

Appendix D: supplementary material of Chapter 5

Bi-variate correlations between study variables (*n* = 141)

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
Vocabulary																									
Theme 1	1. Productive pre	1																							
	2. Receptive pre	.70**	1																						
	3. Productive post	.76**	.79**	1																					
	4. Receptive post	.61**	.72**	.82**	1																				
Theme 2	5. Productive pre	.69**	.68**	.78**	.64**	1																			
	6. Receptive pre	.63**	.63**	.71**	.70**	.72**	1																		
	7. Productive post	.66**	.61**	.77**	.68**	.87**	.73**	1																	
	8. Receptive post	.55**	.57**	.59**	.68**	.59**	.66**	.68**	1																
Theme 3	9. Productive pre	.67**	.67**	.78**	.68**	.78**	.70**	.82**	.63**	1															
	10. Receptive pre	.59**	.60**	.67**	.68**	.65**	.63**	.69**	.69**	.69**	1														
	11. Productive post	.62**	.63**	.75**	.68**	.70**	.62**	.79**	.66**	.83**	.68**	1													
	12. Receptive post	.56**	.57**	.64**	.62**	.52**	.56**	.62**	.63**	.65**	.67**	.71**	1												
Theme 4	13. Productive pre	.57**	.60**	.64**	.62**	.76**	.66**	.78**	.60**	.73**	.67**	.69**	.60**	1											
	14. Receptive pre	.49**	.52**	.60**	.62**	.60**	.61**	.68**	.65**	.62**	.65**	.72**	.71**	.68**	1										
	15. Productive post	.55**	.51**	.62**	.62**	.69**	.63**	.77**	.63**	.65**	.60**	.69**	.63**	.83**	.69**	1									
	16. Receptive post	.33**	.39**	.47**	.50**	.44**	.48**	.52**	.55**	.43**	.49**	.48**	.54**	.52**	.68**	.59**	1								
Implementation Quality[1]																									
	17. Parent meeting	-.05	-.03	-.02	.08	-.16	-.07	-.06	-.10	-.12	-.08	-.08	.03	-.13	-.05	-.10	-.08	1							
	18. Diaries	.02	.09	.12	.15	.13	.15	.23**	.17	.04	.06	.12	.07	.23**	.12	.26**	.14	.34**	1						

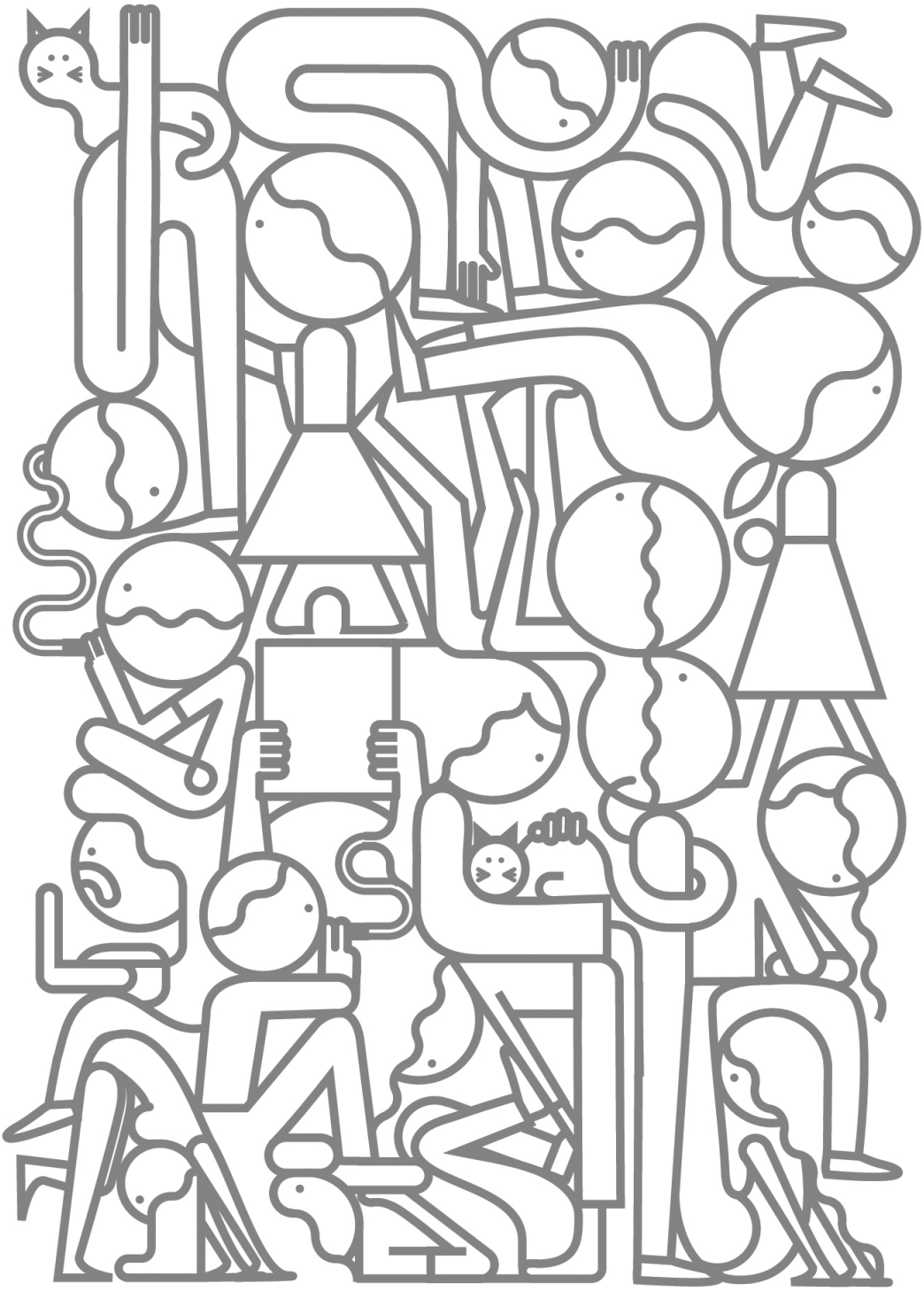
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
Background Variables																								
19. Child age	.31**	.23**	.29**	.25**	.25**	.20**	.25**	.31**	.24**	.26**	.24**	.19**	.16*	.14	.23**	.11	.03	-.01	1					
20. Child gender[2]	.13	.21**	.22**	.23**	.03	.09	.05	.15*	.15*	.19**	.21**	.24**	.06	.16*	.00	.17*	.05	.02	.03	1				
21. EF	.51**	.51**	.58**	.52**	.55**	.48**	.50**	.38**	.49**	.47**	.50**	.46**	.44**	.40**	.44**	.24**	-.04	.24**	.31**	.09	1			
22. SF	.49**	.47**	.58**	.51**	.54**	.47**	.57**	.41**	.51**	.47**	.58**	.49**	.48**	.49**	.43**	.34**	-.13	.07	.29**	.15*	.50**	1		
23. Mother edu.	.04	.07	-.05	-.03	.03	-.04	-.07	.08	-.04	.02	.02	.12	.09	.17*	.10	.10	.10	.14	.06	-.14*	.09	-.04	1	
24. Linguistic div.[3]	.49**	.40**	.49**	.40**	.61**	.49**	.56**	.42**	.53**	.50**	.48**	.39**	.54**	.38**	.44**	.26**	-.19*	.03	.09	.07	.29**	.31**	-.05	1

[1] Only computed for experimental children ($n = 89$)

[2] Gender: boy = 0, girl = 1

[3] Linguistic diversity: L2 = 0, L1 = 1

*$p < .05$ **$p < .01$



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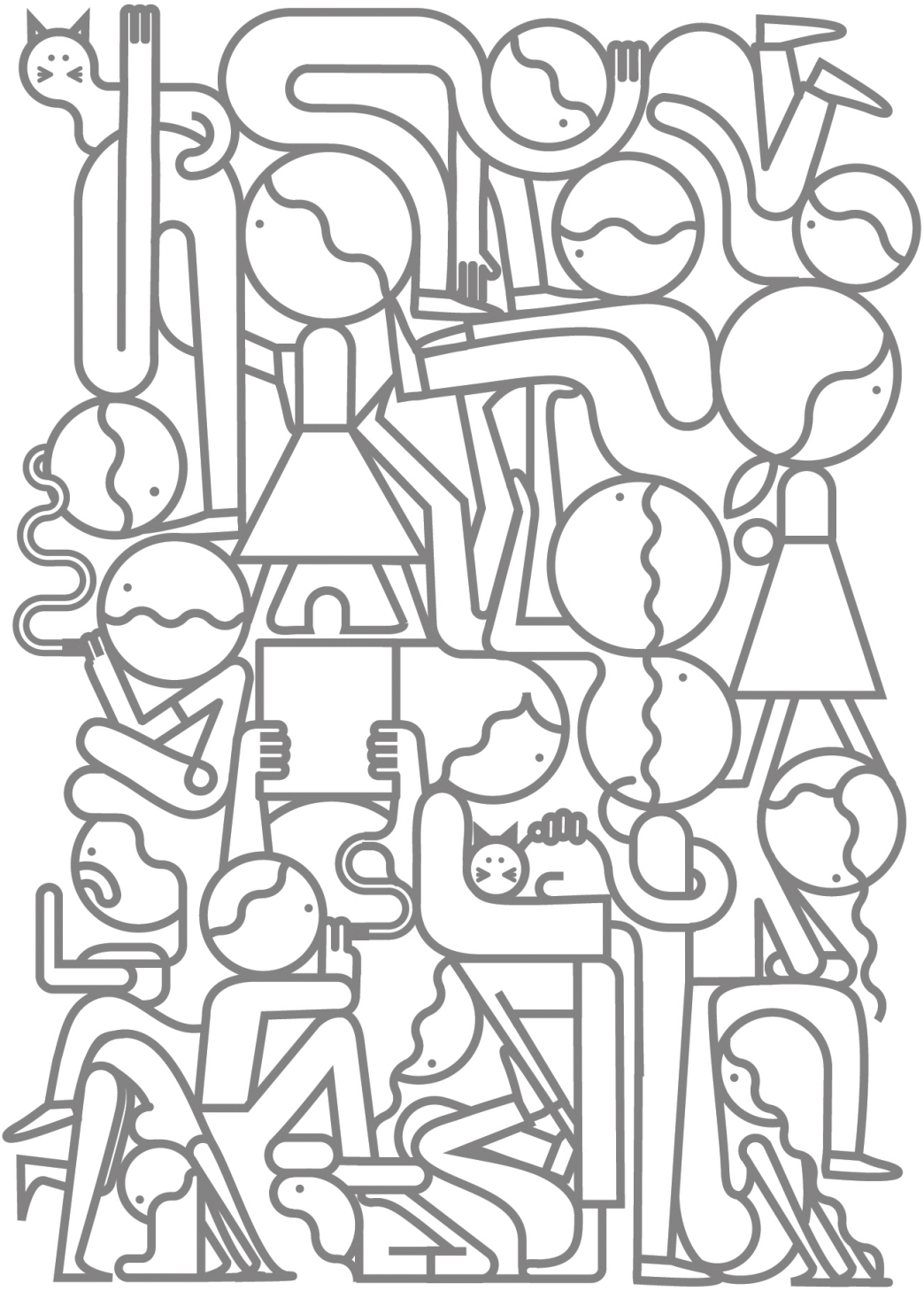


Summary

Early childhood is a critical period for the development of vocabulary. At two-to-four years of age, already large differences exist in the size and developmental rate of children's vocabularies. This variation is known to be due to differences in the family context and the quantity and quality of verbal interactions children experience. Less clear is which role cognitive and social abilities of the child, such as their executive and social functioning, play in explaining vocabulary variation. Therefore, the first aim of this dissertation was to further explain variation in preschoolers' vocabulary. Children with smaller vocabularies are at risk for falling behind and starting formal schooling with delays. Family literacy programs aim to support children's vocabulary by training parents' interaction behavior and providing language stimulating activities to be conducted at home. Although these programs generally have positive effects, vocabulary gains are relatively small because programs seem to insufficiently change parent's interaction behavior at home. The second aim of the present dissertation was therefore to investigate vocabulary effects of two alternative approaches to deliver a family literacy program: active learning (AL) and technology-enhanced learning (TL). The following two research questions were addressed in this dissertation:

1. How can the variation in preschool children's vocabulary be explained from the family context and the child's functioning?
2. Are active learning (AL) and technology-enhanced learning (TL) effective ways to deliver a family literacy program and to foster children's vocabulary development?

Variation in preschool vocabulary

How parent-child interaction influences vocabulary depends on the family context and the child's functioning. Although research showed the effect of the family context on vocabulary (e.g., linguistic diversity, parental education), the role of a child's functioning has received less attention. Children's executive functioning (EF) influences how linguistic input is processed and their social functioning (SF) is important for maintaining social interaction. To examine the first research question, child and family characteristics were studied in relation to children's vocabulary. The studies in Chapter 2 and 5 examined predictors of preschool vocabulary, specifically the additional contributions of children's EF and SF to vocabulary. EF, SF and family contextual factors were measured in 223 Dutch preschool children. Results demonstrated that EF and SF strongly predicted children's vocabulary in addition to their age, linguistic diversity at home and parental education. EF and SF were therefore important factors to

take into account when investigating vocabulary and vocabulary interventions in preschool children. Moreover, this study showed the importance of integrating the family context and the child's functioning when examining preschool children's vocabulary.

Effects of family literacy programs

To examine the second research question, three studies were conducted and described in Chapter 3, 4 and 5. In Chapter 3, the technology-enhanced storytelling activity Jeffy's Journey was developed to support parent–child interaction and vocabulary in preschool children. Technology-enhanced storytelling entailed shared verbal storytelling supported by a story structure and real-time visual, auditory and textual prompts on a tablet computer. In an exploratory study, it was investigated how technology-enhanced storytelling influenced parent–child interaction and vocabulary. An experimental pretest-intervention-posttest design was followed with 44 three-year-old children and their parents in the experimental group and 27 peers in the control group. Results revealed that technology-enhanced storytelling stimulated active child involvement and generated parent–child interaction, yet a great variety in technology-enhanced storytelling characteristics both in time spent and usage of prompts was found among participants. Dyads that spent more time on story phases showed more and higher quality parent–child interaction. The usage of prompts was associated with improved parent–child interaction quality. Finally, an effect of technology-enhanced storytelling was evidenced on children's productive vocabulary. From Chapter 3 it could be concluded that technology-enhanced storytelling can be considered as a promising context for fostering parent–child interaction and children's vocabulary development.

To increase the impact of family literacy programs, two ways to support parents in changing their interaction behavior were examined: active learning during parent group meetings (AL) and technology-enhanced learning with real-time interaction support (TL). In the AL condition, active learning activities, such as modeling, role play and interactive discussions, were used to deliver the family literacy program. In the TL condition technology-enhanced storytelling was further investigated by exmining it as a way to deliver a family literacy program. The family literacy program central to this dissertation was Early Education at Home. Chapter 4 and 5 present the outcomes of the one-year intervention study on the family literacy programs. In these chapters, the family and child characteristics were included in the models as covariates to control for vocabulary variation between children and provide clear program

effects. In a quasi-experimental design, 223 preschool children and their parents were enrolled in a family literacy program with AL (n = 72), TL (n = 73) or in the control condition without a family literacy program (n = 78). All children were also involved in preschool education programs.

Results of the evaluation at the end of the year (Chapter 4) showed that the family literacy program with AL was effective for stimulating children's receptive curriculum-based and receptive standardized vocabulary. This indicated that the AL affected both vocabulary learned within the preschool curriculum as outside the preschool. The family literacy program including TL appeared to have no effect on children's vocabulary at the end of the year. Using the technology-enhanced storytelling activity as a way to deliver a family literacy program to parents did not seem effective for children's vocabulary development after one year. On productive vocabulary development, children in all three conditions made similar gains. These results demonstrated the strength of AL and showed the complexity of implementing TL.

Chapter 5 further examined vocabulary effects of AL and TL. In this chapter, curriculum-based vocabulary tasks were administered four times during the intervention period, to examine the direct relationship between the intervention and children's development. Positive effects of both AL and TL on curriculum-based receptive vocabulary development were found. Children in the AL and TL conditions outperformed children in the control group who were not involved in a family literacy program. No effects were found on productive vocabulary development. Moreover, no differential effects of AL and TL were found for children from different family backgrounds (i.e, linguistic diversity and educational level) or for children with higher or lower EF and SF.

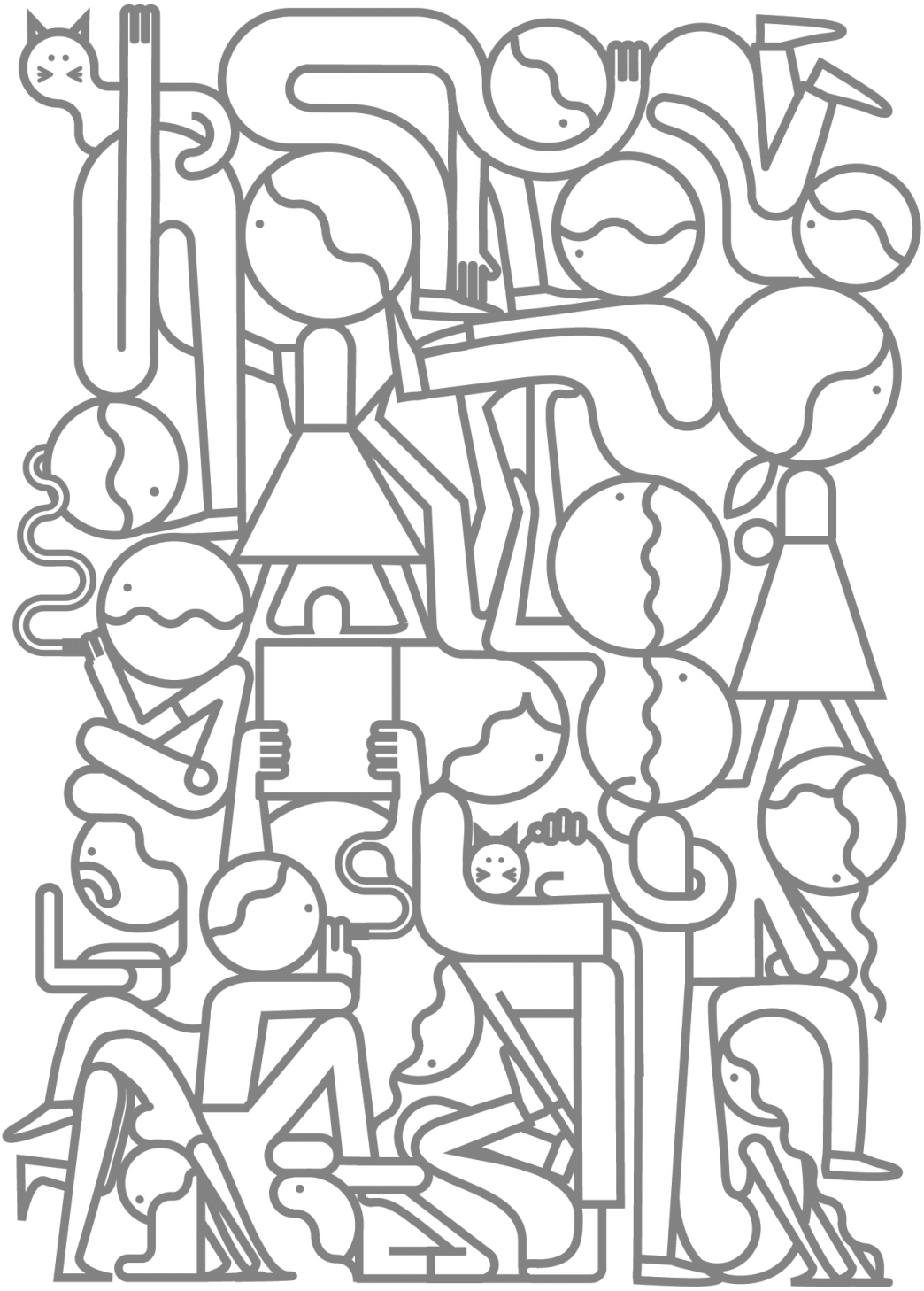
Conclusions and implications

The present dissertation showed that variation in preschool vocabulary can be explained from the family context and the child's functioning. Children's executive and social functioning have a large impact on children's vocabularies. Teachers and program developers should be aware that children differ in how they process linguistic input and also in the way they participate in social interactions. Adapting educational content and instruction to cognitive strengths and weaknesses, will allow children to optimally learn from preschool education.

AL and TL were both found to be effective ways to foster preschool children's receptive vocabulary development within a family literacy program, with the AL variant found to have a larger impact on children's vocabulary development. Involving parents in active learning activities and technology-enhanced

learning was an effective way to produce changes in their children's receptive vocabulary development. However, it should be mentioned that effects were relatively small considering the effort and investment involved when implementing the programs. The absence of an effect on children's productive development indicates that parents could be trained more intensively to activate linguistic output in their children. Moreover, attention should be paid to training preschool teachers in their new role as instructor and trainer of parents. Extensive organizational and social teacher skills are required to successfully implement a family literacy program. Although the technology-enhanced storytelling activity itself promoted productive vocabulary and generated high quality parent-child interaction, implementing these type of activities in a family literacy program is complex and challenging. The success of technology-enhacend learning within a family literacy program largely depends on technological conditions (e.g., wifi connections and technological skills of parents and teachers).

The positive results for children's receptive vocabulary development of both the AL and TL condition indicate that policy makers should consider investing in family literacy programs to foster preschoolers' development. Considering the challenges faced in the TL condition and its smaller impact on vocabulary development, for now, the most efficient way to support children's vocabulary seems to be AL. The family literacy programs fit the needs of all families and children. The program was equally effective for families and children with different backgrounds. Even within the light of the considerable investment and relatively small yield, it is advised to provide all families the opportunity to enhance their child's vocabulary through a family literacy program.



Samenvatting

De vroege kinderjaren vormen een belangrijke periode voor de ontwikkeling van woordenschat. Voor jonge kinderen is woordenschatkennis essentieel om de wereld om zich heen te begrijpen, om te communiceren met anderen en om op latere leeftijd te leren lezen en schrijven. Op twee- tot vierjarige leeftijd, de voorschoolse periode, bestaan er al grote verschillen tussen kinderen in het aantal woorden dat zij kennen en snelheid waarmee ze nieuwe woorden leren. Uit eerder onderzoek is bekend dat een groot deel van deze variatie toe te schrijven is aan verschillen in de familiecontext (o.a. thuistaal en opleidingsniveau van de ouders) en de kwantiteit en kwaliteit van verbale interacties die kinderen thuis ervaren. Minder duidelijk is welke rol executieve en sociale vaardigheden van het kind in deze variatie spelen. Daarom was het eerste doel van dit proefschrift om variatie in de woordenschat van kinderen in de voorschoolse leeftijd te verklaren en daarbij de familiecontext en vaardigheden van het kind te combineren.

Kinderen met een kleinere woordenschat lopen het risico om achterop te raken en de basisschool met een achterstand te starten. Gezinsgerichte programma's hebben als doel de woordenschatontwikkeling van deze kinderen te ondersteunen in de thuissituatie. Gezinsgerichte programma's bieden taalstimulerende activiteiten aan om thuis uit te voeren in combinatie met trainingen om de interactievaardigheden van ouders te verbeteren. Hoewel deze programma's over het algemeen positieve effecten laten zien, is de woordenschatwinst die zij boeken relatief klein. Dit lijkt te komen doordat de programma's er onvoldoende in slagen om het interactiegedrag van ouders thuis daadwerkelijk te veranderen. Het tweede doel van dit proefschrift was daarom om de woordenschateffecten in kaart te brengen van twee alternatieve benaderingen om de interactievaardigheden van ouders te trainen binnen een gezinsgericht programma: actief leren (AL) en technologie-ondersteund leren (TL). In dit proefschrift stonden de volgende twee onderzoeksvragen centraal:

1. Hoe kan variatie in woordenschatkennis van voorschoolse kinderen worden verklaard vanuit de familiecontext en de vaardigheden van het kind?
2. Zijn actief leren (AL) en technologie-ondersteund leren (TL) effectieve manieren om een gezinsgericht programma over te dragen en de woordenschatontwikkeling van voorschoolse kinderen te bevorderen?

Variatie in voorschoolse woordenschat

Vroege woordenschatontwikkeling is een informeel leerproces dat tot stand komt via verbale interacties tussen ouders en kinderen. Dit leerproces wordt beïnvloed door factoren in de familiecontext en door de vaardigheden van

het kind. Onderzoek heeft herhaaldelijk laten zien dat bepaalde factoren in familiecontext, zoals thuistaal en het opleidingsniveau van de ouders, een belangrijke rol spelen in de kwaliteit en kwantiteit van ouder-kindinteractie en daarmee de woordenschatontwikkeling van kinderen. Hoewel de executieve en sociale vaardigheden van kinderen ook van groot belang zijn voor ouder-kindinteractie en woordenschat, is de rol van deze vaardigheden in eerder onderzoek onderbelicht gebleven. Executieve vaardigheden beïnvloeden hoe kinderen taalkundige input verwerken en hun sociale vaardigheden zijn belangrijk voor het in stand houden van interactie. Om de eerste onderzoeksvraag te beantwoorden zijn de invloeden van de familiecontext en de vaardigheden van kinderen op de vroege woordenschatontwikkeling bestudeerd. In Hoofdstuk 2 en 5 zijn de belangrijkste voorspellers van voorschoolse woordenschat in kaart gebracht, met daarbij een focus op de executieve en sociale vaardigheden van kinderen. Van 223 voorschoolse kinderen in de leeftijd van 2,5 tot 3,5 jaar zijn de executieve vaardigheden, sociale vaardigheden en eigenschappen van de familiecontext gemeten. De resultaten toonden aan dat de executieve en sociale vaardigheden van kinderen sterke voorspellers waren van hun woordenschatkennis. Daarnaast waren de leeftijd van het kind, de thuistaal en het opleidingsniveau van de moeder van belang. Oudere kinderen, eentalige opgevoede kinderen en kinderen met hoger opgeleide ouders hadden een grotere woordenschat. Dit resultaat laat zien dat het belangrijk is om factoren in de familiecontext en vaardigheden van het kind geïntegreerd te onderzoeken, en dat met al deze factoren rekening gehouden moet worden als effecten van woordenschatinterventies worden onderzocht.

Effecten van gezinsgerichte programma's

Om de tweede onderzoeksvraag te beantwoorden zijn drie studies uitgevoerd welke zijn beschreven in Hoofdstuk 3, 4 en 5. In Hoofdstuk 3 is een verhaalactiviteit met technologie-ondersteuning ontwikkeld, genaamd Jeffy's Avonturen. Het doel van deze digitale activiteit was om de kwantiteit en kwaliteit van ouder-kindinteractie te ondersteunen en op die manier woordenschatontwikkeling te bevorderen. Tijdens de digitale verhaalactiviteit vertelden ouder en kind gezamenlijk een verhaal waarbij ze ondersteund werden door een verhaalstructuur en real-time visuele, auditieve en tekstuele prompts. De activiteit werd uitgevoerd op een tabletcomputer. In een exploratieve studie is onderzocht hoe Jeffy's Avonturen ouder-kindinteractie en woordenschat beïnvloedde. Na verschillende pilots is een experimenteel pretest-interventie-

posttest onderzoek uitgevoerd, met 44 driejarige kinderen en hun ouders in de experimentele groep en 27 leeftijdsgenoten in de controlegroep. De resultaten lieten zien dat Jeffy's Avonturen actieve deelname van zowel ouders als kinderen stimuleerde en ouder-kindinteractie genereerde. Er waren grote verschillen tussen ouder-kindparen in de tijd die er aan de activiteit werd besteed en de mate waarin de prompts werden gebruikt. Ouder-kindparen die meer tijd besteedden aan de activiteit lieten een hogere kwaliteit van ouder-kindinteractie zien. Het gebruik van de aanwijzingen was ook positief gerelateerd aan ouder-kindinteractie kwaliteit. Tenslotte is er een effect van de activiteit op de productieve woordenschat van kinderen vastgesteld. Uit Hoofdstuk 3 kan geconcludeerd worden dat een verhaalactiviteit met technologie-ondersteuning beschouwd kan worden als een veelbelovende context om ouder-kindinteractie en woordenschatontwikkeling te bevorderen.

Om de effecten van gezinsgerichte programma's te vergroten zijn vervolgens twee manieren om ouders te ondersteunen in hun interactievaardigheden onderzocht binnen de context van een gezinsgericht programma: actief leren tijdens ouderbijeenkomsten (AL) en technologie-ondersteund leren met real-time interactie ondersteuning (TL). In de AL-conditie werden de programma-activiteiten overgedragen via activerende leeractiviteiten, zoals modeling, rollenspellen en interactieve discussies. In de TL-conditie werd de technologie-ondersteunde verhaalactiviteit verder onderzocht als een manier om een gezinsgericht programma aan ouders over te dragen. Het gezinsgerichte programma dat centraal stond was het programma VVE Thuis voor Peuters, ontwikkeld door het Nederlands Jeugdinstituut.

In Hoofdstuk 4 en 5 zijn de resultaten van een eenjarige interventiestudie naar de effecten van AL en TL gepresenteerd. In deze hoofdstukken zijn de kenmerken van de familiecontext en de vaardigheden van kinderen in de analysemodellen opgenomen als covariaten om te controleren voor woordenschatverschillen tussen kinderen en om duidelijke programma-effecten te kunnen vaststellen. Aan de quasi-experimentele interventiestudie namen 223 voorschoolse kinderen en hun ouders deel. Zij volgden het gezinsgerichte programma met AL (n = 72), met TL (n =73) of zaten in de controleconditie zonder gezinsgericht programma (n = 78). Alle deelnemende kinderen namen deel aan voorschoolse educatie via peuterspeelzalen of voorscholen.

Resultaten van de evaluatie aan het eind van het jaar (Hoofdstuk 4) lieten zien dat het gezinsgerichte programma met AL effectief was voor het stimuleren van de receptieve woordenschat van kinderen. Er waren positieve effecten op de curriculum-afhankelijke en gestandaardiseerde receptieve woordenschattaak.

Dit laat zien dat AL zowel van invloed is op woordenschat binnen als buiten het programma. Het programma dat via TL werd overgebracht bleek aan het einde van het schooljaar geen effect te hebben op de woordenschat van kinderen. Op productieve woordenschat ontwikkelden de kinderen in alle drie de condities zich op gelijke wijze en zijn geen effecten van AL of TL vastgesteld. Deze resultaten weerspiegelen de kracht van AL en de complexiteit van de implementatie van TL.

In Hoofdstuk 5 zijn de woordenschateffecten van AL en TL verder onderzocht. In dit hoofdstuk werden de curriculum-afhankelijke woordenschattaken geanalyseerd die vier keer tijdens de interventieperiode zijn afgenomen. Deze manier van meten maakte het mogelijk om de directe relatie tussen de interventie en de ontwikkeling van kinderen te onderzoeken. Op de receptieve curriculum-afhankelijke woordenschattaken die gedurende de interventie zijn afgenomen werden positieve effecten gevonden van zowel de AL- als TL-conditie. Kinderen in de AL- en TL-condities scoorden hoger dan de kinderen in de controlegroep die niet betrokken waren bij een gezinsgericht programma. Wederom zijn er geen effecten gevonden op de productieve woordenschat van kinderen. Bovendien werden er geen differentiële effecten van AL en TL gevonden voor kinderen met verschillende familieachtergronden (thuistaal of opleidingsniveau) of kinderen met hogere dan wel lagere executieve en sociale vaardigheden.

Conclusies en implicaties

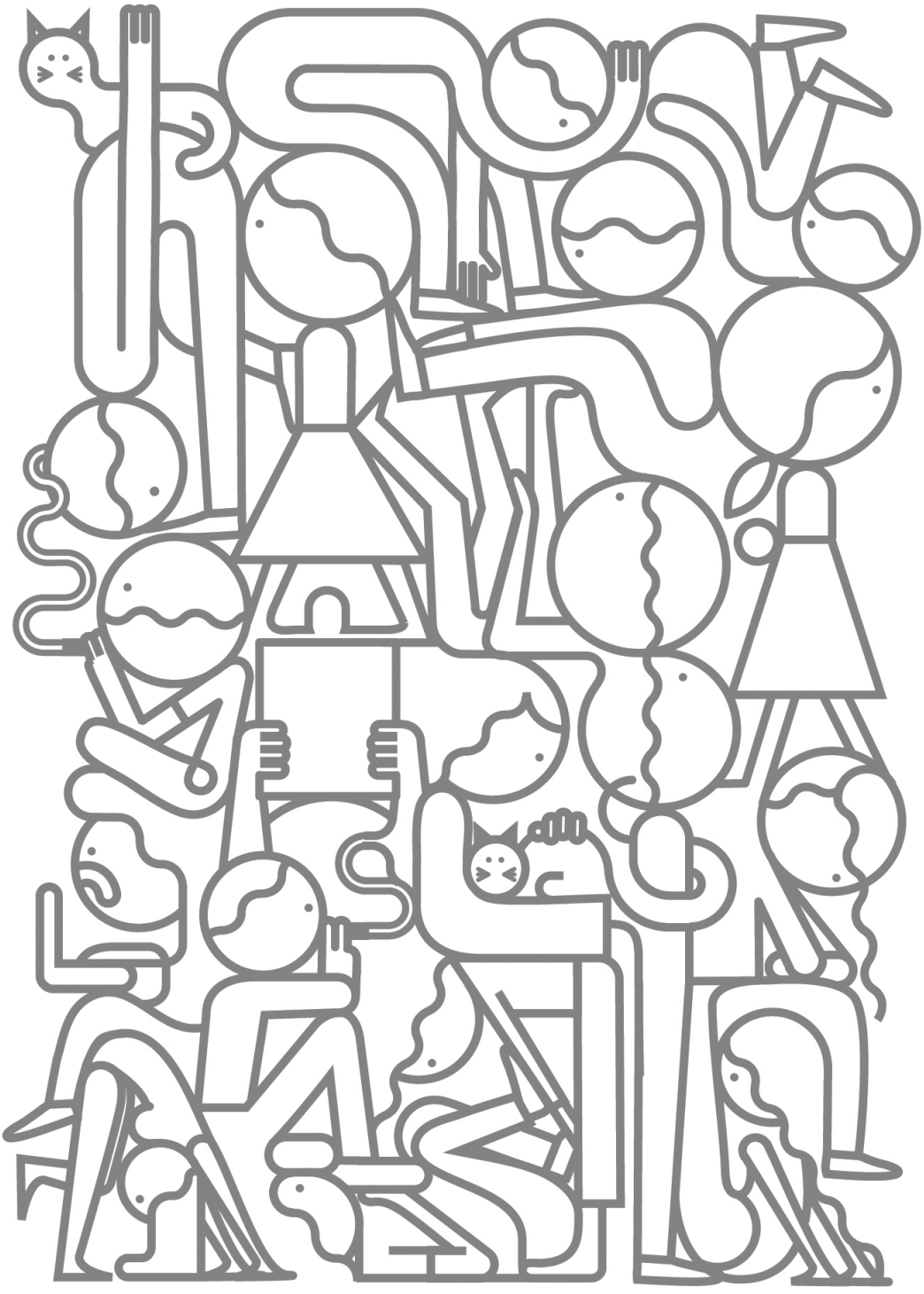
Het huidige proefschrift toont aan dat de variatie in voorschoolse woordenschat verklaard kan worden vanuit zowel factoren in de familiecontext als de vaardigheden van het kind. Executieve en sociale vaardigheden zijn van grote invloed op woordenschat van kinderen. Pedagogisch medewerkers en programmaontwikkelaars moeten zich er daarom van bewust zijn dat kinderen verschillen in de manier waarop zij talige input verwerken en ook in de manier waarop zij deelnemen aan sociale interacties. Het aanpassen van educatieve inhoud en instructies aan de cognitieve en sociale vaardigheden zal kinderen in staat stellen optimaal te profiteren van voorschoolse educatie.

Actief leren (AL) en technologie-ondersteund leren (TL) zijn beiden effectief gebleken manieren om de receptieve woordenschat van kinderen te bevorderen binnen de context van een gezinsgericht programma. Ouders betrekken in actieve leeractiviteiten en technologie-ondersteunde activiteiten is een effectieve manier om woordenschatontwikkeling van kinderen te stimuleren. De AL-variant was hierbij van grotere waarde dan de TL-variant.

De reden hiervan kan de complexere implementatie van TL zijn. Wel zijn de gevonden effecten zijn relatief gering en is de inspanning en investering om de programma's te implementeren groot. De afwezigheid van een effect op productieve woordenschat geeft aan dat ouders nog intensiever begeleid zouden kunnen worden om talige output bij hun kind te activeren.

Om dergelijke programma's succesvol te implementeren moet er aandacht besteed worden aan het trainen van pedagogisch medewerkers in hun nieuwe rol as trainer van ouders. Uitgebreide organisatorische en sociale vaardigheden zijn een vereiste om gezinsgerichte programma's succesvol over te dragen op ouders. Hoewel de technologie-ondersteunde verhaalactiviteit an sich de productieve woordenschat bevorderde en hoge kwaliteit van ouder-kindinteractie genereerde, is het implementeren van dergelijke activiteiten in een gezinsgericht programma complex. Het succes van technologie-ondersteund leren hangt grotendeels af van technologische omstandigheden, zoals wifi-verbindingen en technologische vaardigheden van ouders en pedagogisch medewerkers.

De positieve resultaten van AL en TL op de receptieve woorden-schatontwikkeling van voorschoolse kinderen geven aan dat beleidsmakers het breder inzetten van gezinsgerichte programma's zouden moeten overwegen. Op dit moment lijkt de AL-aanpak de meest efficiënte manier om de woordenschat van kinderen te ondersteunen, gezien de kleinere effecten van TL en de complexiteit van de implementatie. De gezinsgerichte aanpak blijkt aan te sluiten bij de behoeften van verschillende typen gezinnen. Ook in het licht van de aanzienlijke investering en de relatief geringe effecten, is het advies daarom om alle gezinnen de mogelijkheid te bieden om via gezinsgerichte programma's de woordenschatontwikkeling van kinderen te bevorderen.



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Teepe, R. C., Molenaar, I., Oostdam, R. J., Fukkink, R. G., & Verhoeven, L. (2017). Helping parents enhance children's vocabulary: effects of a family literacy program. *Revised manuscript resubmitted, Early Childhood Research Quarterly.*

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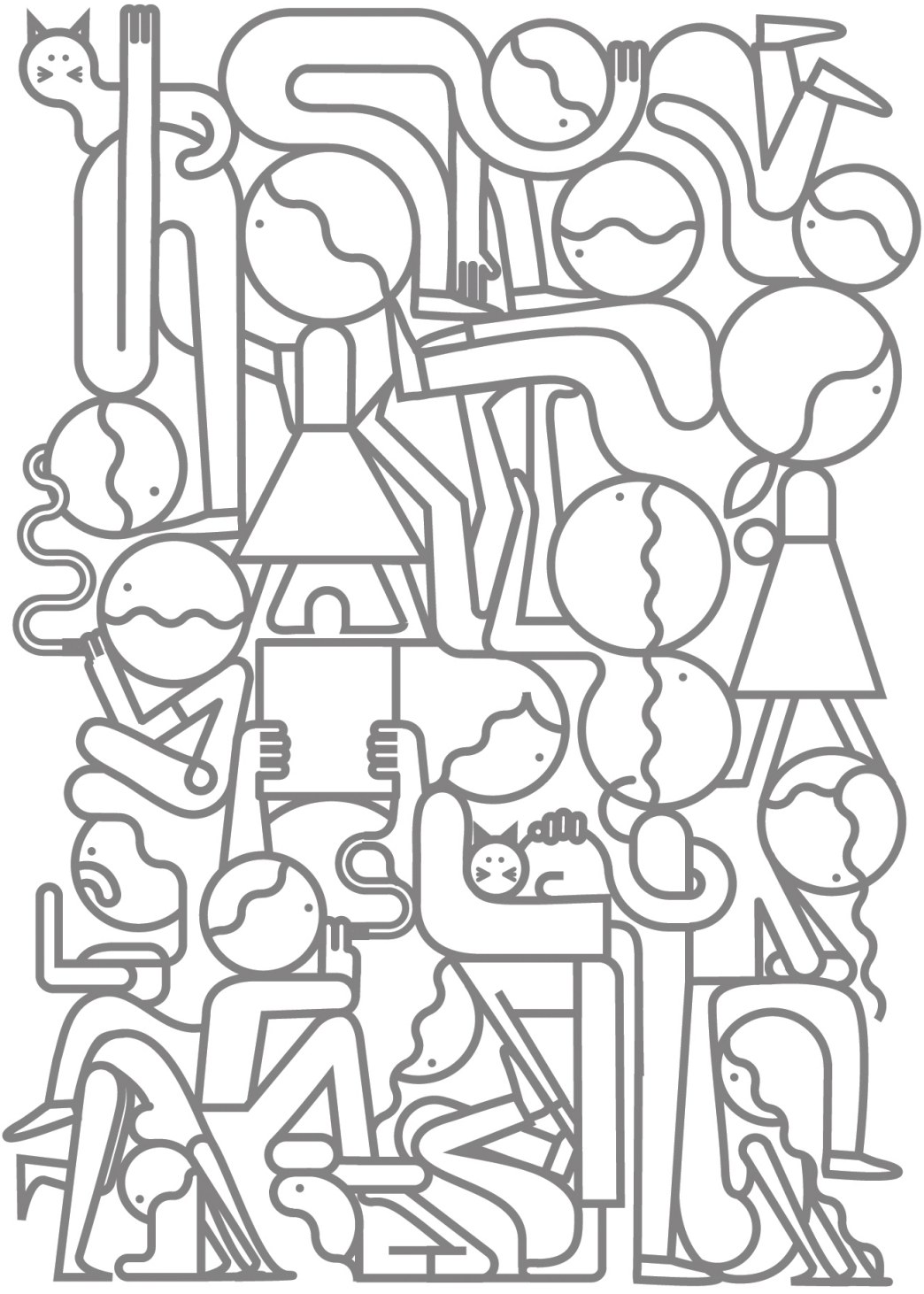
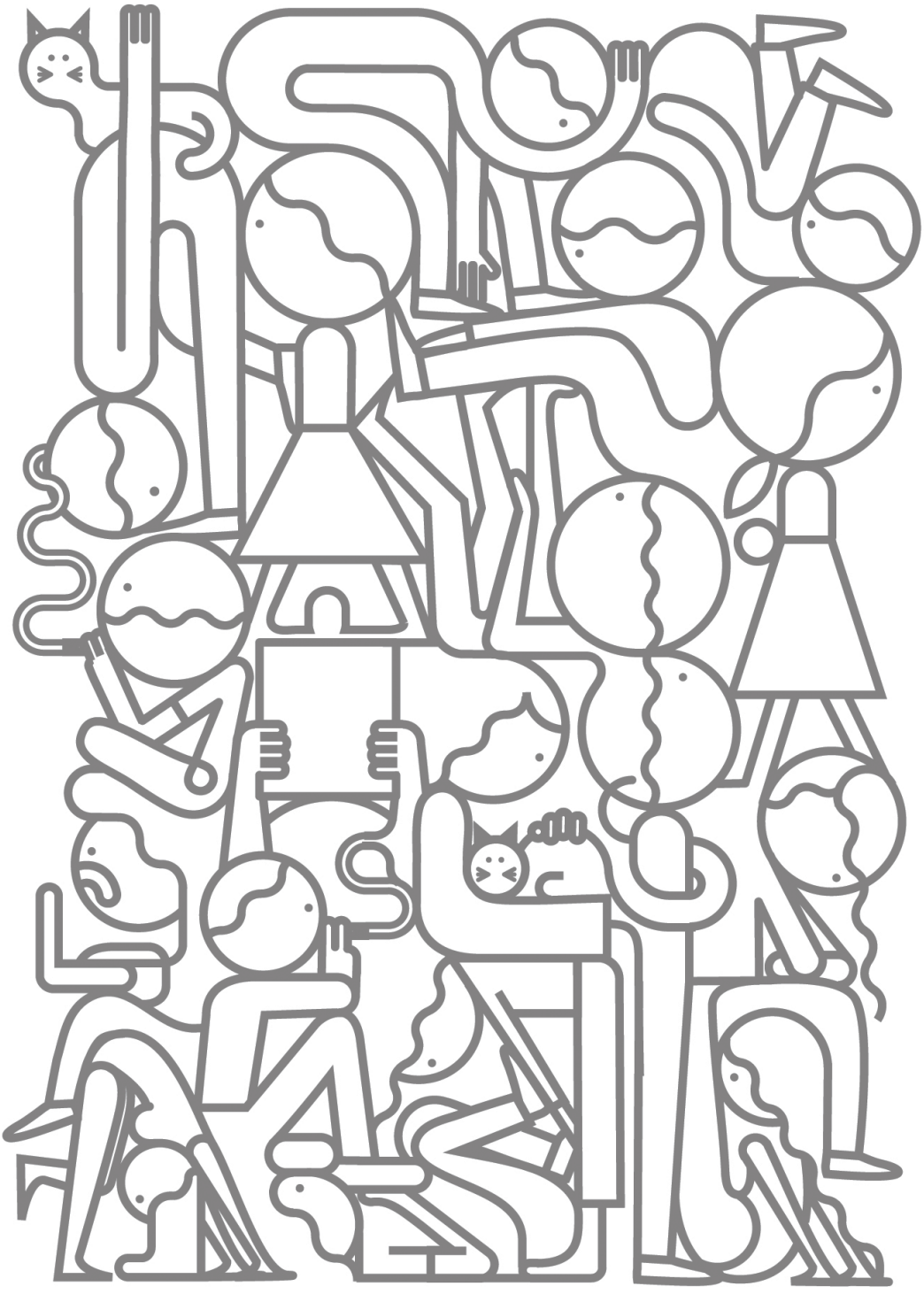


About the author

Rosa Catharina Teepe was born on 20 March 1988 in Raalte, the Netherlands. During pre-university education she developed an interest in language development within the educational context. In 2006 she therefore started her Bachelor studies in Language and Communication at University of Amsterdam. As part of her studies she spent a semester at the Linguistic Department of the University of Toronto, Canada. She finished her Bachelor (2011) with a thesis about the use of argumentation analysis in Dutch pre-university education. Thereafter she started her Master studies in Dutch as a Second Language at University of Amsterdam. She completed a research internship at Kohnstamm Institute, a research centre on educational research. For her thesis she investigated the use of reading strategies of monolingual and bilingual low-achieving adolescents. After she received her Master's degree (2012, cum laude) she started working on her PhD project at Radboud University Nijmegen. She investigated vocabulary development in preschool children and vocabulary effects of family literacy programs. Throughout her PhD she worked as a university teacher, providing courses and supervision of bachelor and master students. In November 2017 she started working as a researcher and language consultant at the Center of Expertise for Language Acquisition in Amsterdam (ITTA).



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