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Do teacher talk features mediate the effects of shared reading on preschool children's second-language development?

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ABSTRACT

This study examined whether a shared reading intervention in preschools serving multilingual populations in Norway had effects on teacher talk quality and whether these effects mediated child second-language outcomes. Four hundred sixty-four children aged 3–5 years participated. They attended 123 classrooms that were randomly assigned to a shared-reading intervention condition or a comparison condition. The children's second-language vocabulary and grammar skills were assessed pre- and post-intervention, with 7.4 months between the 2 assessments. We asked whether the intervention affected qualities of teacher talk hypothesized to impact children's language, and whether identified changes in teacher talk mediated child second-language vocabulary and grammar outcomes. Results revealed that by the end of the school year teachers in the intervention group demonstrated significantly higher quality in their talk during shared reading, assessed as diversity of word types, use of word explanations and ratio of multi-clause utterances. These differences in teacher talk quality explained variance in children's second-language vocabulary outcomes by the end of the intervention year, but not in their second-language syntactic comprehension.

1. Introduction

The many dual language learners (DLLs) in preschool classrooms around the world depend on supportive language environments to become proficient speakers of their second languages, which are typically societal languages of educational importance. Research over the last decades has drawn attention to the importance of inviting all preschool-aged children, and particularly DLLs, to participate in the kind of cognitively challenging talk, including talk about text, that prepares them for academic success; such success requires knowledge acquired through language interactions and skills derived from participation in academic discourse (Aarts et al., 2016; Barnes & Puccioni, 2017; Dickinson & Smith, 1994; Gámez et al., 2017; Leseman et al., 2019; Neuman & Kaefer, 2018; Uccelli et al., 2019; Zucker et al., 2013). Still, we have limited knowledge of the specific qualities of teacher talk during shared reading that may promote development in these domains by DLLs. In this paper we examine whether a shared reading intervention developed to support DLLs' language learning in Norwegian preschools and shown in a randomized controlled trial to improve their second-language outcomes also impacted qualities of teacher talk, and whether any effects on teacher talk mediated relationships between condition assignment (receiving the intervention or comparison condition) and child language outcomes in the domains of second-language vocabulary and grammar comprehension.

Theoretically, the study is grounded in a social-interactionist, pragmatically oriented framework. The framework was originally proposed by Vygotsky (1978) who identified the role of the more knowledgeable other within the zone of proximal development in explaining learning. The nature of the social-interactive learning support was further developed by Bruner (1981), and Snow (1977) and later supported by a rich literature (Golinkoff et al., 2018; Hoff, 2006; Lieven, 2019; Rowe, 2012). The social-interactionist position seeks to understand language learning as resulting from qualities of interactional input, embedded in particular sociocultural contexts and shaped by expectations and norms for interacting in the communities in which children grow up (Grøver et al., 2019; Ford et al., 2020). Empirically, the present study draws on 2 related domains of research: intervention studies addressing effects of book-based professional development programs on teacher talk and shared reading intervention studies

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identifying effects of teacher talk quality on children's vocabulary and grammar.

1.1. Does professional development change teacher book-sharing behaviors?

Because classroom talk reflects teachers' personal histories and styles of language use, it is not surprising that shared-reading intervention studies examining the effects of professional development on teacher talk have generated mixed results (for discussion, see Hindman & Wasik, 2012). Several large-scale studies have found small or no impacts of various forms of professional development (workshops, group mentoring, remote or in-person manualized coaching) on teacher support for children's language development during classroom practices that included, but were not limited to, shared reading (Dickinson et al., 2008; Lonigan et al., 2011; Piasta et al., 2017; Powell et al., 2010). Other studies of professional development involving individual coaching in how to facilitate book discussion through teachers' open-ended questions (Lorio & Woods, 2020; Milburn et al., 2014; Wasik et al., 2006; Wasik & Hindman, 2020), responsiveness to child talk (Cabell et al., 2015) and support for child participation (Dickinson & Caswell, 2007) have reported increased sophistication and responsiveness of teacher talk. Also Buysse et al. (2010), in a study that addressed DLLs speaking English and Spanish, found measurable improvements in the quality of teachers' language practices, resulting from professional development that included practice-based coaching in how to share books in both languages.

Mendive et al. (2016) demonstrated that introducing entirely new classroom practices in professional development interventions is less likely to promote change. Some features of teacher talk may thus be more influenced by professional development than others. Piasta et al. (2012) succeeded, for example, in increasing teachers' use of moves designed to encourage and prolong classroom conversations (wait time, slowing the conversational pace, cuing turn-taking with questions), but did not find effects of professional development focused on teaching new language forms or promoting more abstract or extended talk. In contrast, Girolametto et al. (2007) and Rezzonico et al. (2015) demonstrated measurable gains in teachers' inferential questioning resulting from in-service or individualized coaching. Divergent results may reflect prior teacher knowledge about ways of supporting children, potentially impacting teachers' responsiveness to professional development (Cunningham et al., 2009) and may also reflect ways in which professional development programs adjust to teacher expectations and beliefs. Programs that are not well-aligned with professional expectations in the local culture (Bleses et al., 2018), or that recommend practices that appear fragmented (Justice et al., 2008), may be less successfully implemented, as would be predicted by the social-interactionist position viewing language input and learning as embedded in sociocultural norms and expectations for teacher-student interaction. In summary, while professional development focusing on well-practiced contexts such as shared reading can improve teacher questioning strategies and responsiveness to child talk, more general effects on the quality, complexity and cognitive challenge of teacher talk have not been robustly documented in the literature.

1.2. How does adult talk during book sharing relate to child language outcomes?

Several decades ago Whitehurst and colleagues' experimental studies confirmed the effects of dialogic reading on child vocabulary (Whitehurst et al., 1988) and grammar (Valdez-Menchaca & Whitehurst, 1992); dialogic reading is characterized by the adult inviting child talk through open-ended questions and through adaptation to the child's emerging language skills. Both experimental and correlational studies of interaction qualities during shared reading have since then documented positive associations between dialogic reading and child outcomes (for reviews, see Noble et al., 2019; Mol et al., 2008; U.S. Department of Education, 2007). More content-focused studies examining how teachers support language learning through cognitively complex questions and invitations to reason and to build background knowledge during shared reading have complemented the dialogic reading studies and have also found child outcome effects (Barnes et al., 2017; Dickinson & Smith, 1994; Dickinson et al., 2014; Lennox, 2013; Neuman & Kaefer, 2018; Neuman et al., 2016).

The most widely evaluated child outcome measure is vocabulary, and thus features of adult word use in the input (number of words, diversity of words, sophistication of words, syntactic complexity) have also frequently been studied; vocabulary diversity and syntactic complexity are also key adult input factors predicting preschool-aged children's vocabulary skills outside of shared reading contexts (for recent reviews, see Anderson et al., 2021; Rowe & Snow, 2020).

A meta-analysis of book-sharing interventions showed large effects on parents' book-sharing competencies, with smaller but significant effects on children's expressive and receptive language (Dowdall et al., 2020). Other systematic reviews of the effects of shared reading on children's language outcomes found effects on expressive rather than receptive vocabulary for monolinguals (Mol et al., 2009). Fitton et al. (2018) replicated this effect, and also found a wider range of impacts from shared reading, for DLLs.

Some classroom intervention studies have reported positive effects on teacher support for language learning, but not on child language outcomes (Piasta et al., 2020; Powell et al., 2010). Interventions that have positively influenced both teacher talk and child outcomes are rare, but Wasik et al. (2006) reported positive effects of professional development targeting shared reading on teachers' use of language-supporting strategies and on children's expressive and receptive vocabulary, a finding replicated by Wasik and Hindman (2011, 2020).

Most shared reading studies report medium to large effects on children's knowledge of vocabulary words targeted in the intervention, while effects on general, nontargeted vocabulary are less commonly reported (Grøver et al., 2020; Dowdall et al., 2020; Neuman & Kaefer, 2018; Wasik et al., 2016). Positive effects were associated with offering explanations of word meanings when teaching new vocabulary words (Coyne et al., 2009; Isbell et al., 2004; Neuman & Kaefer, 2018; Nevo & Vaknin-Nusbaum, 2018; Penno et al., 2002). Findings by Justice et al. (2005) suggest that adult exploration of and elaboration on word meanings produces the learning, and that the shared-reading context does not have an independent effect, though it does increase the density of novel and low-frequency vocabulary items.

Classroom studies on the effects of teacher syntactic complexity on child vocabulary have arrived at divergent conclusions, with Farrow et al. (2020) demonstrating an effect while Justice et al. (2018) found none. Interestingly, Farrow et al. reported that it was teacher syntactic complexity during morning messages and small group meetings, and not during shared reading specifically, that showed relations to child vocabulary, suggesting that the variance in teacher talk was larger when the teacher did not have the support from the text in constructing more complex utterances. The Farrow et al. study included a smaller number of DLLs. Studies that address DLLs in particular have only partly confirmed relations between teacher syntactic complexity and child vocabulary. Gámez (2015) reported that teacher talk diversity and syntactic complexity was related to 5- to 6-year-old

DLLs' expressive vocabulary. In a follow-up study Gámez and colleagues (2017) compared teacher support for vocabulary learning in similarly-aged DLLs and their English-only peers during activities that included shared reading and concluded there were no differential effects of teacher complex syntax on child vocabulary as a function of language status, a conclusion that differed from Gámez and Lesaux's (2012) study of sixth-graders that did find teacher complex syntax be more beneficial for English-only children's vocabulary. Bowers and Vasilyeva (2011) demonstrated a positive relation between DLLs' vocabulary growth and the total number of teacher-produced words, while the relation to teacher syntactic complexity was negative. The authors pointed out that the children had low initial second-language vocabulary scores and that deconstructing complex teacher utterances may have complicated the task of learning new words from teacher talk.

Beyond vocabulary, there is some evidence that adults' syntactic complexity is positively associated with children's syntactic growth (Hoff-Ginsberg, 1986; Huttenlocher et al., 2002; Justice et al., 2013). Book-sharing is a context during which adult talk is typically more syntactically complex than during activities such as toy play (Crain-Thoreson et al., 2001; Demir-Lira et al., 2019; Farrow et al., 2020; Noble et al., 2018), thus perhaps supporting syntactic development in unique ways. A few studies have documented an increase in children's MLU (mean length of utterance) (Isbell et al., 2004; Lake & Evangelou, 2019; Rezzonico et al., 2015), in their morphology (Nevo & Vaknin-Nusbaum, 2018), and in their syntactic comprehension (Senechal et al., 2008) as a result of participation in shared reading interventions. Studies addressing DLLs in particular have reported divergent results of shared book reading on second-language syntactic comprehension, with Authors (2020) demonstrating an effect while Aarts et al. (2016) did not. Negative results may reflect lack of parent and teacher skill in book-sharing; dialogic reading interventions designed to increase parents' use of open-ended questions and of responses to children's utterances did result in longer child utterances (Whitehurst et al., 1988).

Summing up, only a few studies have examined whether changes in caregiver talk as result of participating in an intervention study were associated with and/or could explain effects of book-sharing on child language outcomes. Intervention studies often do not report on sample language status or discuss potential differential intervention effects for monolingual vs bilingual learners (Walker et al., 2020), and those that have addressed DLLs in particular report divergent findings. Across student populations there is some evidence that use of diverse vocabulary, word explanations and syntactically complex utterances in teacher talk during shared reading have positive effects on child vocabulary and grammar, but not all studies confirm these relationships. There is thus little evidence about potential impacts of shared reading interventions on teacher talk quality, let alone how such potential impacts may support children's language learning.

1.3. The present study

The present study examined whether a researcher-developed shared reading intervention in preschools serving multilingual populations in Norway had effects on teacher talk quality and whether these effects mediated child language outcomes. Classrooms were randomly assigned to an intervention or comparison condition. The shared-reading intervention included supervision and support to teachers in interactive and content-focused strategies to use when sharing books with children, such as asking open-ended questions and adapting to student language skills (interactive features), as well as explaining targeted vocabulary words, encouraging child reasoning, and inviting identification of different perspectives in the text (content-focused features). The children's language skills were assessed pre- and post-intervention, with about 7.4 months between the 2 assessments. Previously we have demonstrated that the shared reading intervention significantly improved children's receptive knowledge of second-language vocabulary and grammar (Grøver et al., 2020). In the present study we ask whether the intervention affected qualities of teacher talk hypothesized to impact children's language (diverse vocabulary use; word explanations, and complex syntax), and then whether any changes in teacher talk mediated the child effects previously reported. More specifically we asked the following 2 research questions:

RQ1: Were there differences in teacher talk quality toward the end of the intervention year between teachers who received the shared reading intervention and teachers who did not receive it?

RQ2: Did teacher talk quality have an indirect effect on (mediate) child second-language vocabulary and grammar outcomes?

2. Method

2.1. The Norwegian early childhood education context

Norwegian early childhood education is universal and mostly publicly funded (Engel et al., 2015). It is guided by a national framework plan that emphasizes children's free play, opportunities for exploration, and peer interaction as important to their development and learning (Norwegian Directorate for Education and Training, 2017). The plan identifies 7 learning areas out of which 'Communication, language, and text' is one. Schools are free to select curricular priorities throughout the year. Children in Norway typically attend the nearest local preschool, in most cases located in walking distance from where they live. The demographics of preschools thus typically reflect the demographics of the neighborhoods in which they are located. Norwegian is the common language used in preschools by staff and children.

2.2. Participants

2.2.1. Children

Participants in the study included 464 DLLs (49.6% girls) identified by their parents as bilingual. Children were in the age span 3–5 years, with a mean age in months at pretest of 52.60 ($SD = 9.63$) and at posttest 60.03 ($SD = 9.67$). The children spoke a variety of first languages with the larger first-language groups being Urdu (20.3% of the children), Somali (14.0%), Polish (9.7%) and Arabic (9.3%). Parental education levels varied; a majority of the parents had high school education or less as their highest level of education (67.4% of the mothers and 65.9% of the fathers) (information based on telephone interviews by bilingual research assistants). Most mothers (92.3%) and fathers (92.4%) were born outside Norway and had immigrated to Norway as young adults before the child was born (mean age in years at immigration for mothers was 21.9 ($SD = 8.46$) and for fathers 24.4 ($SD = 8.25$)). Of the 411 mothers for whom we have information on what language they used in communication with the child, 70.1% responded that they mostly used their first language and 20.9% that they used a combination of the first language and Norwegian, while 65.8% reported that the child used a combination of Norwegian and first language or mostly Norwegian in communication with them (for further information on family language use, see Rydland & Grøver, 2021). Most children had entered preschool before age 3 (age in months at entrance: $M = 26.11$, $SD = 10.72$).

2.2.2. Teachers and classrooms

The children attended 123 preschool classrooms in 60 preschools in the greater Oslo area. The mean number of children participating in the study per class was 3.77. Each classroom

had a lead teacher and a couple of teacher assistants (mean number of staff per classroom was 3.15 (SD = 0.71) (based on questionnaire information offered by lead teachers). The classrooms reflected the age-heterogeneous composition of preschools in Norway; any classroom would typically include a mixture of 3-, 4-, and 5-year olds. The preschools served a linguistically highly diverse student population, and close to 2 out of 3 children in the average classroom had parents who both spoke a language different from Norwegian at home. Most lead teachers were females (12.2% males), 49.6% had a degree in early childhood education and another 26% had additional relevant education following their early childhood education degree. Other lead teachers were in the process of acquiring an early childhood degree or had other education backgrounds. More than half of the lead teachers (52.1%) had 6 or more years of experience as classroom leaders, and a third had 10 or more years of experience. Three out of four lead teachers had identified curricular priorities according to the national framework plan, and of these, 82.8% responded that they prioritized the learning area 'Communication, language and text'.

2.2.3. Randomization procedures

We recruited children by first inviting preschool teachers working in city districts with a high percentage of immigrant families to volunteer for the study. The teachers distributed information about the study to parents in their classrooms. To be eligible for the study children had to be identified as DLLs by their parents and have parents who had a non-Scandinavian language as their first language. For a classroom to be included in the study a minimum of 2 families had to agree to participate. To optimize similarity in socioeconomic background between treatment and control classrooms we applied a 2-step randomization procedure after recruitment was completed. First, in preschools with an even number of participating classrooms we randomly selected half of the classrooms into intervention and control condition; 98 classrooms were assigned condition through this first step of randomization. In the second step 12 multiple-classroom preschools with 1 classroom that had not been assigned condition in the first step and 14 one-classroom preschools were divided into pairs based on location; in each pair 1 classroom was randomly assigned either intervention or control status. Immediately following randomization, 1 intervention classroom withdrew from the study due to staff illness, resulting in 61 intervention and 62 control classrooms.

We compared child and family demographics in the intervention and control conditions at pretest by conducting an independent samples t-test accounting for cluster effects. With the exception of child age in months (mean age in months in the intervention group was 53.84 (SD = 9.51) and in the control group 51.19 (SD = 9.60); $t(464) = 2.09$, $P = 0.039$) there were no demographic differences between children and families in the 2 conditions. We compared teacher and classroom characteristics using independent samples t-tests and found no differences between conditions. During the year, 16 children in the intervention group and 18 in the control group exited the study because their families moved out of the area. Because three of the exiters were the only participating children in their intervention classroom, we lost the classroom. One child in the intervention group left the study because his teacher reported that he showed distress when asked to sit during shared reading.

2.3. Measures and procedures

2.3.1. Child assessments

The children's second language skills were individually assessed pre- and post-intervention by trained research assistants who were not informed about the condition of the classrooms they visited. Assessments were conducted by a Norwegian-speaking research assistant in a quiet room in the preschool with no time limits imposed. The analysis of whether teacher talk quality had an indirect effect on child second-language vocabulary and grammar outcomes (RQ2) is based on 1 vocabulary (VOC_RECEPTIVE) and 1 grammar (TROG-2) assessment for which we found a total intervention effect. They were both receptive and part of a larger battery of assessments that were administered in a fixed order. Included in this battery was also the BPVS-II (Dunn et al., 1997), a general receptive vocabulary assessment for which we found no total intervention effect (Grøver et al., 2020). We thus did not use the BPVS-II data to calculate indirect effects of teacher talk quality.

VOC_RECEPTIVE was a researcher-developed vocabulary test consisting of 46 items. We developed it to assess the children's knowledge of words they were exposed to in the shared reading intervention. We selected words that appeared in the children's books and that we considered useful for content-rich discussions. Most of the words appearing in the test (41 items) were targeted in the intervention (the teachers were asked to discuss their meaning with children), but we also included some additional words that we considered useful when sharing the book, such as the word 'frog' in a wordless book about frogs. The child was shown panels of 4 pictures and asked to point to the picture that matched the word said by the assessor. Children were credited with one point for reference to each correct item, no stop rules were applied. Cronbach's alpha was 0.74.

TROG-2 (Bishop, 2003), adapted to Norwegian, was used to assess children's syntactic comprehension. We used 3 sets (set C, D, and E, in total 12 items). The child was shown panels of 4 drawings and was asked to point to the drawing that matched the sentence said by the assessor (one point per correct response). Cronbach's alpha was 0.76.

2.3.2. Teacher and classroom quality prior to the intervention

Classroom Assessment Scoring System (CLASS). We used the CLASS instrument (Pianta et al., 2007) to observe 3 domains of classroom quality (emotional support, classroom organization, and instructional support) prior to the intervention. The research assistants attended a 3-day training-course offered in Norwegian and passed the 80% interrater reliability criterion that is demanded to become a certified CLASS-observer. In addition, after their first rounds of observations, the research assistants discussed their notes and scoring with the project's 'Train the trainer of CLASS' to ensure the correct use of the instrument. To adapt to early childhood education in Norway, where large slots of time during the day are dedicated to free peer-directed play, we decided to observe in predefined situations to secure adult presence in some of the targeted situations. Research assistants thus observed classroom interaction during 20 consecutive minutes in 3 preselected situations during an ordinary preschool day prior to the intervention: circle time or another teacher-led activity, meal-time, and peer play. We used the scoring criteria from 1 to 7 for each variable/domain in the CLASS instrument and developed descriptive statistics for each domain based on CLASS guidelines.

Snapshot Observations. In order to provide a more global picture of language interactions and language use in the classrooms, a simple snapshot observation scheme was developed and piloted by the two first authors. We coded whether, and in which language, the target child verbally interacted with teachers and/or peers. The development of the scheme was based on time-sampling strategies developed by Howes and Smith (1995) and de Haan et al. (2014). Previous snapshot-based studies have demonstrated that DLLs have few verbal interactions with teachers and peers in either language (Franco et al., 2019). The snapshot observation scheme included 4 main interaction categories (Teacher interacted verbally with target child/Target child interacted verbally with teacher/Peer(s) interacted verbally with target child/Target child interacted verbally

Table 1
Pre-intervention classroom quality as assessed by CLASS. Independent samples *t*-test.

	Intervention group, $n = 61$		Control group, $n = 62$		*t*-value	*P*-value
	M	*SD*	*M*	*SD*		
Socio-emotional quality	5.48	0.69	5.32	0.70	1.28	0.20
Classroom management	4.61	0.76	4.46	0.79	1.07	0.29
Instructional quality	2.16	0.75	2.02	0.74	1.00	0.32

Table 2
Pre-intervention classroom quality as assessed by snapshot-observations. Independent samples *t*-test accounting for cluster effects.

	Intervention group			Control group			*t*-value	*P*-value
	n	*M*	*SD*	*n*	*M*	*SD*		
Teacher interacted verbally with target child	121	4.31	3.09	109	4.87	3.07	-1.10	0.28
Peer(s) interacted verbally with target child	121	5.51	3.83	109	5.78	4.07	-0.03	0.98
Target child interacted verbally with teacher	121	3.50	3.19	108	4.33	3.25	-1.87	0.07
Target child interacted verbally with peer(s)	121	6.62	4.06	108	6.18	4.17	0.52	0.61
Target child involved in text-related activity	121	0.57	1.76	110	0.79	1.67	0.82	0.41

with peer(s)) and within each category we marked which language was used (Norwegian or other language). If the target child interacted verbally with a teacher and peers during the sampled time, it was scored as interaction with a teacher, while the categories of peer interaction included only peers. We also identified the extent to which the child was involved in text-related activity (defined as any activity related to shared reading, looking at or talking about a book, playing that involved a book, drawing or other activities that involved letters or writing). To assess interobserver reliability prior to data collection 2 observers simultaneously and independently rated target child interaction with teachers and peers in 75 snapshots. These observations were conducted during 1 day in 1 preschool with several different children targeted for observation. The calculation of inter-rater reliability yielded a Cohen's kappa of 0.90 (from interaction partner to target child) and 0.93 (from target child to interaction partner) respectively. None of the observers identified any language use outside of Norwegian or any text-related activities during the 75 snapshots, and thus reached full agreement in the rating of these categories. Research assistants were trained in a 2-hour workshop and discussed their first snapshot observations with the project leaders to confirm their use of the scheme.

For snapshot data collection we randomly selected approximately half of the children. For each of 231 children (121 intervention children) we have completed 20 snapshots of 20 consecutive seconds. The assistants had a timer that signaled when a snapshot started and ended, and each snapshot was followed by 40 seconds during which the assistant coded the interaction. The snapshot observations were done randomly throughout the preschool day, typically 5–10 snapshots in a row.

Comparing Interaction Quality Across Conditions Prior to the Intervention. We compared pre-intervention classroom quality as assessed by CLASS, using independent samples *t*-test (see Table 1), and as assessed by the snapshot observations, using independent samples *t*-test accounting for cluster effects (see Table 2). There were no differences between conditions in any of the 3 CLASS domains; socio-emotional quality, classroom management or instructional quality. Also, there were no differences between conditions when targeted children were snapshot-observed prior to the intervention in verbal interactions with teachers and peers or in text-related activity. Across conditions, teachers were verbally interacting with the target child in less than a quarter of the 20 snapshots. Peers interacted verbally with target children in about 6 out of 20 snapshots. Text-related interaction of any kind appeared rarely during the snapshot observations, in less than 1 snapshot out of 20, and with no differences between conditions (see Table 2). In the 4600 snapshot observations, we identified only 2 occurrences of a teacher talking in a language different from Norwegian to a target child, applying to 2 target children, both attending the same intervention classroom. In 11 snapshots a target child used a language different from Norwegian to a teacher (applying to 10 children in 4 intervention and 6 control classrooms). Norwegian-only language use also characterized peer interactions. In only 63 snapshots was a target child observed to use the first language in interaction with a peer, and similarly, in 56 snapshots only, did a peer talk to the target child in the first language. These first-language peer-interactions were observed in 15 different classrooms, with 1 intervention and 1 control classroom demonstrating a larger number of first-language peer interactions than the rest, and with no differences among conditions. In sum, we conclude that, based on CLASS and snapshot-observations, we did not detect any differences between the conditions prior to the onset of the intervention.

2.3.3. Teacher talk quality during shared reading

During the fourth and last intervention unit teachers in both the intervention and control conditions were asked to audiotape the sharing of a book which had not been used during the intervention. We have in total 121 recordings; in 1 intervention classroom the teacher never completed the task and in another intervention classroom all participating children had moved. We chose a book (Tilberg & Yokoland, 2011) that we did not expect the teachers to know beforehand, and all teachers confirmed that they were unfamiliar with the book. Also, in selecting the book we made sure that the intervention group had no advantages, such as being familiar with the book's main topic and ideas or the presence of words that had appeared as part of the intervention. Through colorful pictures and some text (typically 1 or a few sentences per page) the book covered in a humorous way the theme of being afraid as a feeling that may appear in everyday situations, for example being afraid of saying something or of the dark. The last pages of the book also paid attention to the helpful and protective role of fear in certain situations, by telling us what not to do. We considered the book useful in inviting reasoning and discussion about a feeling every child would recognize. The teachers were allowed to familiarize themselves with the book on the day of the recording and before sharing it with the children and were asked to share it in a way that invited children to engage in talk about the themes covered in the book. Teachers were asked to audiotape the reading with the consented children in the classroom

and to spend the time they needed to read the book. Average reading time was approximately 20 minutes (M = 19.87, range 5.08–45.31 minutes, SD = 7.79).

The audiotaped readings were transcribed using the conventions of the Child Language Data Exchange System, CHAT (MacWhinney, 2000). Utterance boundaries were based on the audiotaped speech information such as intonation contour and pause duration. We were not able to identify individual children's voices with sufficient reliability and transcriptions therefore only distinguished between teacher and child utterances.

As the first step in the analyses of teacher-talk quality during shared reading, we used the transcripts to distinguish all teacher utterances that were read aloud as opposed to utterances that were spontaneously produced as part of discussing the text. Teachers typically make slight adjustments to written text when they read, reflecting their understanding of what children will be able to comprehend or be interested in. For an utterance to be identified as read, it had to be almost identical to the book's written text. In addition to sentences that were read exactly as written in the book, we considered utterances to be read if the teacher omitted or changed 2 or fewer non-essential words or added an extra word. For example, the sentence 'Alle er redde. Alle pappaer og alle mammaer og alle barn' [Everyone is afraid. All dads and all mums and all kids] was still considered a read-aloud if the teacher produced the following utterance: [Everyone is afraid. All dads and mums and kids] or [Everyone is afraid. All dads and all mums and everyone]. The decision whether an utterance was read or not was done by a coder who was blind to condition.

As the second step in the analyses of teacher-talk quality, we identified the following input qualities that in previous studies have been hypothesized to promote child language: teacher types (vocabulary diversity), teacher word explanations and teacher syntactic complexity.

Teacher Types. We calculated the number of teacher types (different words) using the CLAN program freq.

Teacher Word Explanations. Spontaneous word explanations appeared in diverse ways in communication between teachers and children. We identified 3 categories of word explanations.

Category 1: Attention to Words Beyond Simple Naming. The teacher asked what something was called, and then presented the word with a description, such as the teacher in the following example who invited the children to come up with the word 'cone':

Example 1

Teacher:	vet du hva det heter som er oppå trærne?	do you know what it is called, that which is on the trees?
Child:	kongle.	cone.
Teacher:	ja det er kongle.	yes that is a cone.
Teacher:	det er sånn oppå trærne.	that is something on the trees.

Category 2: Simple Word Explanations. The teacher explained the meaning of a word, typically following an invitation to the children to define the word, as seen in the next example in which a teacher spontaneously explained the term 'run out of money':

Example 2

Teacher:	vet dere hva å gå tom for penger betyr?	do you know what it means to run out of money?
Child:	når ingen ting penger.	when no money.
Teacher:	ja, riktig.	right.
Teacher:	å ikke ha noen penger.	to have no money.
Teacher:	pengepungen blir tom.	the wallet becomes empty.

Category 3: Extended Word Explanations. Teachers also offered more in-depth explanations of a word, such as by relating a word to children's previous experiences or to events in books they had read. This teacher, like the previous one, explained the term 'run out of money' (just the first part of the explanation is excerpted in the following example):

Example 3

Teacher:	hva er det, tom for penger?	what is that, to run out of money?
Teacher:	hvorfor er man redd det?	why are we afraid of that?
Child:	jeg er ikke redd for (.) de kan bare gå ned i bank igjen og ta med penger.	I am not afraid of (.) they can only go to the bank and get more money.
Teacher:	hvorfor er man redd hvis man ikke har penger?	why is one afraid if one does not have money?
Child:	de kan ikke gå inn.	they cannot go in.
Teacher:	kan ikke gå inn (.) hvor da?	cannot go in (.) where?
Child:	de kan ikke gå inn for å spille fotball eller noe.	they cannot go in to play soccer or anything.
Teacher:	ja hvis vi ikke har penger til å kjøpe billetter mener du.	yes if we do not have money to buy tickets you mean.
Child:	ja, ikke lov å gå.	yes, not allowed to go.
Teacher:	ja, jeg er redd for at hvis jeg ikke har penger, da kan jeg ikke kjøpe mat da.	yes, I am afraid that if I do not have money then I cannot buy any food.

The coding of word explanations was checked by 2 independent coders who coded 7 transcripts and achieved a Cronbach's alpha of 0.86.

Teacher Syntactic Complexity. We identified all teacher utterances with two or more clauses, adapting the coding conventions developed by Huttenlocher et al. (2002). We defined a clause as an utterance fragment that included a verb. Utterances with an auxiliary verb (can/could/will/would etc) in addition to a lexical verb were categorized as one clause (ex: Han vil ikke leke [He will not play]), in which the fragment 'will not play' was considered one clause. Utterances with infinitival forms of an additional verb (ex.: Har du lyst til å se på? [Do you want to watch?]) were counted as consisting of two clauses. Utterances with a single subject were treated as two clauses if they contained more than one verb phrase as in 'He saw the dog and became afraid'. Utterances with a conjoined subject or object and one verb were treated as one clause (e.g. 'The mother and the baby looked sad' or 'She had a coat and an umbrella').

Multi-clause utterances appeared in different constellations of coordinate, complement and relative clauses, but were not distinguished in the coding. Examples of multi-clause utterances (each including 4 clauses) were: Tror dere / at de øynene tilhører noe farlig / eller er det bare / noen dyr som lever i skogen? [Do you think/ that those eyes belong to something dangerous/ or is it just animals/who live in the woods?]. Det er / når noen får noe / du ikke har / men har lyst på. [That is/when someone gets something/you do not have/but really want]. We excluded in the count teacher utterances that were exact self-repetitions. We did not include false starts where, midway through an utterance, the teacher interrupted herself and for example repeated the utterance from the beginning. Decisions as to whether a teacher statement represented one utterance that included several clauses or consisted of two or more separate single- or shorter multi-clause utterances were of course critical. The transcriber who was blinded to the condition and to the purpose of the study made decisions regarding when an utterance ended and a new started based on information from speech signals. The coder was also blinded to the condition status of the transcripts.

2.4. The Extend intervention

The shared reading program that we called Extend included as the main component shared book reading in preschool (for ad-

ditional program components such as invitation to peer play following shared reading, see Grøver et al., 2020). The program was developed by the first 2 authors in collaboration with a board of experienced preschool leaders and teachers working in the multilingual city districts in which the intervention was undertaken, and introduced 4 thematically defined units ('To travel and to belong', 'To live together and find solutions', 'To be me with my feelings', 'On the savannah in Africa'). Each unit had a 4-week duration to allow time between units with no program activity. We selected books that reflected the overall theme of the unit and that were useful in inviting content-rich discussions with preschool children. We attempted to select books that children in multiethnic preschools could identify with, such as by portraying characters with diverse ethnic backgrounds and/or animals (for discussion of material selection in interventions addressing student groups, see Larson et al., 2020), and asked teachers to adapt their book discussions to the group of children attending. Fifteen books (5 information-based and 10 narrative, out of which 4 were wordless) were selected for the first 15 weeks of the intervention, and on the last week of the fourth unit teachers were asked to revisit the children's favorite books. The teachers were asked to work with each book for 1 week with 3 shared reading sessions and to audiotape the last. Teachers could include any number of children in the 2 first readings while for the last reading only consented children could participate. One book in each unit was sent home and the family was asked to share it in their preferred language. Three of these books were wordless while the fourth included some text that was translated into the respective first languages. The parents were informed about words targeted in preschool, but were not explicitly asked to teach these words to their children. Rather, they were asked to share the book as they normally would (for a more complete presentation of the home reading part of the intervention, see Grøver et al., 2020).

During a shared reading session the teachers were asked to discuss and explain the meaning of 4–5 targeted words and build background knowledge related to those words when relevant. We asked them to encourage reasoning through questions and through inviting children's participation in talk about emotions and perspectives in the text. Each book came with teacher-support material that identified words to be explained and offered examples of how teachers could use the book to address the components of the intervention.

Prior to the intervention the lead teachers participated in a 1-day workshop in which the main features of the Extend intervention were introduced and exemplified. During the intervention year, each teacher was coached once in each thematic unit by 2 authors of the article who visited the teacher in her classroom to discuss implementation challenges.

We collected systematic information on implementation using teacher-reported forms (teachers filled out a form for each book reporting on which students had been present and which intervention components they had worked with) and audiotapes of shared reading. According to teachers' self-reports they had engaged in about 32.69 book readings (SD = 10.51) out of the 45 readings that we planned for. Most teachers reported on working with targeted words, but with variation in frequency. Preschool attendance is not compulsory in Norway and some children attended irregularly. Individual children got on average exposure to about half of the maximum possible number of shared readings, with large variations between children (M = 24.99, SD = 11.08) (for more details on Intervention fidelity, see Grøver et al., 2020).

The control classrooms received 1 or 2 books (7 in total) within each thematic unit that were topically linked to the unit, but not identical with the books that the intervention classrooms received. Teachers in these classrooms received no support material or coaching relevant to the books.

2.5. Analytic plan

To answer RQ1, independent samples t-tests were undertaken to compare teacher talk qualities across conditions. To examine whether potential group differences in teacher talk quality resulted from receiving the intervention, we used the CLASS and snapshot observations collected prior to the intervention.

To respond to RQ2 we used structural equation modeling (SEM) techniques to estimate mediation effects. Teacher talk quality would serve as a mediator to the extent that it accounted for the relation between condition and child language outcome. The SEM technique takes only the common variance among observed variables into account and thus allows for testing of impact without influence from measurement errors. To take cluster effects into account we conducted a 2-level analysis, using the Mplus program (Muthén & Muthén, 1998–2017). Multilevel path analysis was necessary because 3 to 4 students on average were sampled per teacher/classroom and because teacher/classroom was the level of randomization. Missing data were handled using the model-based maximum-likelihood procedures implemented in the Mplus program. To analyze the mediating effects of teacher talk quality, we built 1 model for each language outcome, and used autoregressive techniques with post-intervention language skills as the dependent measure and pre-intervention skills as a control. For the latent variable teacher talk quality we combined 3 observed quality indices. For vocabulary we randomly assigned VOC_RECEPTIVE items into 1 of 3 sets (A–C) and used these to construct the latent variable. For grammar we used the TROG-2's three sets (C–E) to construct the latent variable.

3. Results

3.1. Were there differences between intervention and control teachers in talk quality during an end-of-year book-reading session?

3.1.1. Teachers' and children's contributions during shared reading

Overall, the intervention group spent approximately 2.5 minutes more time on interactive reading. Reading time for the book selected to analyze teacher talk quality was in the intervention group 21.54 minutes (SD = 7.81) and in the control group 18.27 minutes (SD = 7.50), $t(119)$ = -2.35, P = 0.02. The variance within each subgroup was large (range in the intervention group was 8.43–45.31 minutes, in the control group 5.08–40.43 minutes).

The mean number of utterances produced during shared reading (teachers and children) was 377.24 (SD = 159.37). Transcripts varied in total number of utterances from 62 to 997. The mean number of total utterances (teachers and children) was not significantly different between conditions, and the variance within each was large (Table 3). Limiting the comparison to teachers and children respectively confirmed that there were no differences between conditions in mean number of teacher utterances produced, while the children in the intervention group produced marginally more utterances than children in the control group. The teacher was the main contributor of talk during shared reading, with the children on average offering 4 out of 10 utterances. The ratio of child utterances to total number of utterances was higher in the intervention than the control group (see Table 3), suggesting that children in the former group participated more often during shared reading.

Teachers in the intervention group produced more word tokens than teachers in the control condition, and the ratio of teacher tokens per utterance was higher in the intervention group. Both teachers and children in the intervention group produced more word types.

Word explanations were rare, with a mean of just 2.69 across the conditions. The most common type was Category 2 explana-

Table 3
Teachers' and children's talk production during shared reading.

	Intervention group, $n = 59$		Control group, $n = 62$		$t(119)$	P-value
	M	*SD*	*M*	*SD*		
Total number of utterances (teacher and children)	401.81	140.78	353.85	173.15	1.67	0.10
Total number of utterances – teachers	238.56	92.42	216.47	102.83	1.24	0.22
Ratio of child utterances to total number of utterances	0.41	0.08	0.38	0.09	2.06	0.04
Teacher tokens	1755.27	668.27	1486.26	739.30	2.09	0.04
Teacher tokens per utterance	7.43	0.94	6.90	1.30	2.57	0.01
Teacher types	348.88	87.82	308.21	83.00	2.62	0.01
Child types	222.25	68.51	174.40	80.12	3.38	0.001
Number of word explanations	3.44	2.45	1.98	1.83	3.71	<0.001
Number of tokens in explanations- teachers	174.05	143.23	96.47	110.64	3.34	0.001
Ratio of teacher utterances that included 2 or more clauses out of total read utterances	0.63	0.11	0.61	0.11	1.38	0.17
Ratio of teacher utterances that included 2 or more clauses out of total non-read utterances	0.35	0.08	0.29	0.09	3.99	<0.001
Ratio of teacher utterances that included 4 or more clauses (multi-clause) out of total non-read utterances	0.03	0.02	0.01	0.02	5.37	<0.001

tions (simple word explanations) which occurred on average 1.26 times per transcript. Both Category 1 explanations (attention to words beyond simple naming) and Category 3 explanations (extended word explanations) appeared on average less than once per transcript (each had a mean of 0.7 occurrences). We combined the 3 explanatory types in the analyses for a more robust indicator. Sixteen transcripts included no word explanations (5 intervention group and 11 control group transcripts). Only 3 transcripts (2 intervention and 1 control group transcript) included 10 or more word explanations. While the mean number of spontaneous word explanations was low (on average varying between 3½ and 2 in the two groups), the intervention group produced more (Table 3). Not only did the intervention group produce more explanations, but they also produced more tokens per explanation. Word explanations were typically initiated and undertaken by the teachers, though the children also contributed, as illustrated in examples 1–3 above.

Though the analyses we report address teacher talk contributions and their potential effects on child language, in the discussion we return to the fact that children were participating more actively in book discussions in the intervention group.

3.1.2. The text: read and discussed

The talk produced during the shared reading was a mixture of straight reading and spontaneous conversational utterances. There were large differences among teachers in how they related to the text in the book, from 1 teacher who did not read any sentences, but used only the pictures to invite talk and discussions with the children, to another teacher who read all the sentences, but hardly produced any conversational utterances or invited child responses. The large majority of teachers in both conditions, though, combined a strategy of reading the text and offering and inviting comments. There were no differences between the 2 groups in number of utterances that were read in the intervention group (31.45 (SD = 10.31) and in the control group 32.00 (SD = 8.89), $t(119) = 0.31$, $P = 0.76$.) There were also no group differences in the ratio of read utterances to total teacher utterances, with a mean of 0.16 (SD = 0.08) in the intervention and 0.19 ($SD = 0.13$) in the control group, $t(119) = 1.43$, $P = 0.16$.

The ratio of utterances that consisted of 2 or more clauses was significantly higher in utterances that were read ($M = 0.62$, $SD = 0.11$) than in conversational utterances ($M = 0.32$, $SD = 0.09$). These differences reflect that in conversational talk a considerable number of utterances will be short repetitions, confirmations, turn-regulations etc. which typically will be single-clause. There were no differences between conditions in the ratio of read utterances that included 2 or more clauses, but we identified a difference in the ratio of conversational (non-read) utterances that included 2 or more clauses (ratio of such utterances out of total non-read utterances) as well as conversational utterances that included 4 or more clauses (called multi-clause utterances, ratio out of total non-read utterances), in favor of the intervention group (Table 3). Multi-clause utterances were rare, occurring on average less than 7 times per session. The intervention teachers produced on average between 6 and 7 multi-clause utterances ($M = 6.90$, $SD = 5.92$), while the control teachers produced between 2 and 3 such utterances ($M = 2.61$, $SD = 3.85$).

3.2. Did teacher talk quality have an indirect effect on child second-language vocabulary and grammar outcomes?

In our analyses of the mediating role of teacher talk quality during shared reading we decided to focus on diverse vocabulary use, word explanations, and complex syntax, qualities that in previous studies have been found to impact child language outcomes. We used teacher types as an indicator of teacher vocabulary diversity and the absolute number of word explanations as an indicator of teacher explanatory quality. As our focus was on complex teacher syntax, we used the ratio of multi-clause conversational utterances out of total conversational utterances. The 3 teacher talk quality indicators were interrelated; the correlation between types and word explanations was $r = 0.47$ ($P < 0.001$), between types and ratio of multi-clause utterances $r = 0.42$ ($P < 0.001$), and between word explanations and ratio of multi-clause utterances $r = 0.42$ ($P < 0.01$).

3.2.1. Indirect effects of teacher talk quality on vocabulary outcomes

Children's vocabulary scores developed significantly during the preschool year as assessed by VOC_RECEPTIVE ($M = 14.85$, $SD = 5.69$, $N = 446$ at pretest and $M = 20.23$, $SD = 6.65$, $N = 427$ at posttest, $t(425) = 7.64$, $P < 0.001$). There were no significant differences between conditions prior to the intervention in vocabulary scores: $M = 15.19$ ($SD = 5.73$) for the intervention group and $M = 14.47$ ($SD = 5.62$) for the control group, $t(444) = 1.34$, $P = 0.18$), but the groups' post-intervention vocabulary scores differed significantly: $M = 22.40$ ($SD = 6.92$) for the intervention group and $M = 17.77$ ($SD = 5.38$) for the control group, $t(425) = 7.64$, $P < 0.001$.

The fit of the model examining mediation effects on vocabulary outcomes was good ($\chi^2 = 42.51$, $df = 45$, $P < 0.58$; RMSEA = 0.00, CFI = 1.00, TLI = 1.00, SRMR = 0.142 (value for between).The observed variables (vocabulary pre and post and teacher talk quality) loaded significantly on the latent variables, see Table 4. In the model used to examine RQ2, the total effect of the intervention

Table 4
Standardized factor loadings for the two-level measurement model estimating effects of teacher talk quality on vocabulary.

Observed variable	Within level				Between level			
	Estimate	S.E.	Est/S.E.	*P*-value<	Estimate	S.E.	Est/S.E.	*P*-value <
Types					0.617	0.08	7.88	0.001
Explanations					0.681	0.08	8.95	0.001
Ratio of multi-clause utt.					0.674	0.08	8.72	0.001
VOC_A_PR	0.737	0.04	20.87	0.001	0.956	0.08	12.81	0.001
VOC_B_PR	0.537	0.04	12.07	0.001	0.926	0.12	7.57	0.001
VOC_C_PR	0.748	0.04	19.78	0.001	0.911	0.15	5.92	0.001
VOC_A_PO	0.758	0.04	22.57	0.001	0.988	0.02	50.04	0.001
VOC_B_PO	0.579	0.04	13.69	0.001	0.977	0.04	27.02	0.001
VOC_C_PO	0.735	0.04	21.17	0.001	0.981	0.03	32.93	0.001

Note. VOC_A, B and C: Voc_Receptive, three sets A–C.

was estimated at 0.65, $SE = 0.09$, $Est/SE = 7.20$, $P < 0.001$. We found a significant indirect effect of teacher talk quality on post vocabulary (total indirect standardized effect: 0.218, S.E. = 0.08, Est/S.E. = 2.70, $P = 0.007$); as well as a significant direct standardized effect of condition: 0.426, S.E. = 0.11, Est./S.E. = 3.83, $P < 0.001$).

The VOC_RECEPTIVE was 1 of 2 receptive vocabulary assessments that was applied in the study (see Measures and procedures section). While children's BPVS-II scores increased significantly over the preschool year ($P < 0.001$), with a pretest mean score of 27.00 and a posttest mean score 35.78, condition did not explain the growth. There were no differences between the intervention and control conditions in BPVS-II scores prior to the intervention. To examine the extent to which the 3 teacher talk quality indicators predicted growth in vocabulary assessed with the BPVS-II we ran a 2-level mixed model maximum likelihood estimation in Mplus, controlling for BPVS-II pretest and condition status. Teacher types did not explain variance in vocabulary growth in this model. Number of word explanations were borderline significant with a standardized estimate 0.227, $P = 0.07$. Model fit information: $\chi 2 = 3.475$, $df = 1$, $P = 0.06$, RMSEA = 0.075, CFI = 0.991, TLI = 0.949, SRMR = 0.099; BPVS-2 pretest strongly predicted BPVS-2 posttest (standardized estimate 0.72, $P < 0.001$). Ratio of multi-clause utterances significantly explained growth in BPVS-II posttest in the model, with a standardized estimate 0.27, $P = 0.03$. Model fit information: $\chi 2 = 0.62$, $df = 1$, $P = 0.43$, RMSEA = 0.00, CFI = 1.00, TLI = 1.00, SRMR = 0.039; with BPVS-2 pretest strongly predicting BPVS-2 posttest (standardized estimate 0.74, $P < 0.001$). Condition status did not, as expected, explain variance in any of these models.

3.2.2. Indirect effects of teacher talk quality on syntactic comprehension outcomes

Also children's grammar scores increased significantly over the preschool year, from $M = 6.64$ ($SD = 3.11$, $N = 444$) at pretest to $M = 8.29$ ($SD = 2.60$, $N = 426$) at posttest ($P < 0.001$). There were no significant differences prior to the intervention in grammar scores, $M = 6.82$ ($SD = 3.20$) for the intervention group and $M = 6.41$ ($SD = 3.00$) for the control group, $t(442) = 1.39$, $P = 0.17$. The intervention group had higher post-intervention scores ($M = 8.73$, $SD = 2.45$) than the control group ($M = 7.78$, $SD = 2.68$), and the difference was significant, ($t(424) = 3.81$, $P < 0.001$).

We estimated similar models, analyzing direct and indirect effects of teacher talk quality on syntactic comprehension assessed as a latent variable. Model fit was good: $\chi^2 = 58.32$, $df = 47$, $P = 0.12$, RMSEA = 0.023, CFI = 0.987, TLI = 0.983, SRMR = 0.150 (value for between). The observed variables for syntactic comprehension at pre- and post-test and for teacher talk quality loaded significantly on the latent variables (see Table 5). As previously reported (Grøver et al., 2020) we identified a total effect of the intervention on grammar outcomes (in the present model the total standardized effect was estimated at 0.30 ($SE = 0.10$, $Est/SE = 2.95$, $P = 0.003$). We identified no indirect effect of teacher talk quality on children's syntactic comprehension (standardized estimate: 0.126, S.E. = 0.08, Est/S.E. = 1.58, $P = 0.11$), nor did we identify a direct effect of condition on syntactic comprehension in this specific model (standardized estimate: 0.173. S.E. = 0.121, Est/S.E. = 1.43, $P = 0.15$).

4. Discussion

The strongest basis for adapting effective educational interventions is to understand the mechanisms by which they work. The social-interactionist approach that framed this study predicts that quality differences in interactional input would explain some variation in how language is developing. We have previously shown that the Extend intervention is effective in promoting the second-language skills of immigrant children attending Norwegian preschools; in this paper we ask what changes in the classroom talk may have mediated those impacts. The major findings from this effort to understand how the Extend intervention influenced child language outcomes were:

1. Teachers in the intervention group demonstrated significantly higher quality in their talk by the end of the intervention on the following dimensions: number of types, number of word explanations and ratio of multi-clause utterances in conversational utterances during shared reading.
2. These identified differences in teacher talk qualities explained variance in children's second-language vocabulary outcomes by the end of the intervention year, but not in their syntactic comprehension outcomes.

4.1. Features of teacher talk as an effect of condition

Teachers in classrooms receiving the Extend intervention were asked to explain some words in each book, to build knowledge aligned with these words when relevant, and to invite children to discuss the books' ideas and perspectives. The guidelines given to teachers made no mention of using syntactically more complex utterances, but we assumed that complexity might be impacted if teachers were supported to engage in talk about themes that encouraged children's curiosity and reasoning.

A critical question in interventions designed to enhance children's language learning is whether teachers in fact modify their language use as a result of receiving professional development. Our analyses suggested that intervention teachers, at least by the final unit of the intervention, used more word types, spontaneously explained more words, and more often demonstrated the

Table 5
Standardized factor loadings for the 2-level measurement model estimating effects of teacher talk quality on syntactic comprehension.

Observed variable	Within level				Between level			
	Estimate	S.E.	Est/S.E.	*P*-value<	Estimate	S.E.	Est/S.E.	*P*-value <
Types					0.616	0.08	7.62	0.001
Explanations					0.684	0.08	8.52	0.001
Ratio of multi-clause utt.					0.655	0.09	7.53	0.001
TROG_C pre	0.700	0.03	25.75	0.001	0.985	0.14	7.00	0.001
TROG_D pre	0.711	0.03	26.76	0.001	0.959	0.11	8.49	0.001
TROG_E pre	0.698	0.03	25.12	0.001	0.873	0.11	7.74	0.001
TROG_C post	0.610	0.03	18.14	0.001	0.916	0.09	10.05	0.001
TROG_D post	0.612	0.03	18.25	0.001	0.908	0.09	10.10	0.001
TROG_E post	0.581	0.03	17.67	0.001	0.980	0.12	8.18	0.001

Note. Trog_C, D and E: Trog sets C–E.

use of multi-clause utterances than teachers in the comparison group. These changes were embedded in a larger picture of subtle changes: intervention teachers spent more time on reading, and they were more talkative (producing more tokens). Children similarly did more talking, producing more types and a higher proportion of the total utterances in the intervention group. Our mediation findings suggest that something about these changes in teacher talk did reflect developmentally meaningful ways of interacting with children (see Piasta et al., 2017, for a counterexample).

As we do not have observations of teacher talk quality across conditions prior to the intervention, we cannot be absolutely sure that these differences were a result of receiving the professional training that was part of the intervention. However, the randomized design and a number of data sources indicate that the intervention and control groups were equivalent prior to the intervention in ways that we also expect to encompass teacher talk quality: there were no differences in any parent or teacher demographics or in teacher-reported classroom characteristics, and no differences along any dimension of teacher-child interaction quality as assessed by the CLASS instrument, in the frequency of teacher-child and peer-child interactions or in text-mediated interactions as assessed by snapshot observations. Finally, there were no pre-existing differences between conditions in children's second-language vocabulary and grammar skills pre-intervention.

The findings align with prior reports that teachers who had received professional development as part of an intervention program modified their interactive reading in various ways: a greater number of open-ended or reasoning questions, more informational questions, more encouragement to use theme-related vocabulary, and more support for conversation, demonstrated in teachers serving monolingual children (Cabell et al., 2015; Lorio & Woods, 2020; Piasta et al., 2012; Wasik et al., 2006; Wasik & Hindman, 2020) as well as those serving linguistically diverse groups (Milburn et al., 2014; Rezzonico et al., 2015). The present study adds to the small number of studies that have examined teacher talk modifications, resulting from professional development, during interactive reading with DLLs.

Irrespective of children's language statuses, other studies have found no effects of professional development on teacher support for children's language development (Dickinson et al., 2008; Lonigan et al., 2011; Piasta et al., 2017). Lonigan et al. suggested that large variability between preschool centers within the experimental group could explain the absence of significant findings. In the current study we also found high levels of variability across teachers in both control and intervention groups on precisely the indicators of greatest interest; it seems likely that the relationship between high quality teacher talk and children's language outcomes is strong enough to obscure the positive effects of an intervention (as shown by Gámez and Lesaux, (2012) for somewhat older children). The variability across teachers coexists with considerable stability over time within teachers, in the way they interact with children during reading, with only small changes that can be attributed to professional development (Wasik et al., 2006). Nonetheless, we did see intervention-induced changes in teacher talk strategies, that may reflect the fact that we were not introducing entirely new practices. Even though text-mediated activity was very infrequent in the preschools we observed, sharing books with children was a familiar activity for the teachers and was also foregrounded in one of the Framework plan's prioritized curricular areas. These familiar practices may have been susceptible to being implemented more often or in subtly different ways than entirely novel practices (Mendive et al., 2016).

According to the social-interactionist approach we applied, the particular sociocultural setting within which teacher-child interaction takes place, is expected to be developmentally significant. Thus, cultural and contextual factors may contribute to whether an intervention program succeeds in changing teachers' instructional interactions (Bleses et al., 2018). In the present study we developed a softly scripted intervention to accommodate to Norwegian preschool teachers' ideas and beliefs about developmentally beneficial ways of interacting with young children. A more manualized intervention program, though perhaps desirable and effective in some educational settings, probably would have been rejected by Norwegian preschool teachers and made program components harder to integrate. If distinct features of professional development interventions that each may be well-grounded in recommended practices are not woven together to reflect a more global quality, the program as a whole may not facilitate development (Justice et al., 2008).

4.2. Teacher talk quality as a mediator of child second-language vocabulary and grammar outcomes

Teacher talk quality as defined in the present study explained unique variance in vocabulary scores by the end of the intervention year, thus accounting for part of the intervention effect. The intervention nurtured attention to a set of words that all appeared in literature for children in the pertinent age group and were useful in talking about ideas in this literature. Thus, the children in the control group likely encountered many of these words as well, but without the support of discussions or explanations that seem to have mediated their learning. Classroom intervention studies often report positive effects on the classroom environment and on classroom support for early literacy and language development, but none on child language outcomes (Piasta et al., 2020; Powell et al., 2010), though Piasta et al. (2012) reported greater linguistic productivity and complexity in the talk of children interacting with their teachers in small-group activities toward the end of an intervention year.

The conclusion that adults using a rich vocabulary can support children's word learning during shared reading is robustly supported (see Dowdall et al., 2020, for a systematic review). Findings regarding the impact of teacher syntactic complexity on children's vocabulary are more divergent. Justice et al. (2018) found that teachers' complex utterances did not make a contribution to vocabulary growth in a diverse sample of children. Gámez and Lesaux (2012) in a study of sixth-graders, concluded that teachers' use of syntactically complex utterances benefited the vocabulary of English-only children more than DLLs, and also demonstrated that it was DLLs with the more advanced vocabulary skills who benefited from teacher complex syntax. Bowers and Vasilyeva (2011) indeed found a negative relation between teacher syntactic complexity and DLLs' vocabulary growth, arguing that the children did not have sufficient linguistic skills yet to make use of syntactic information in word learning. Farrow et al. (2020), on the other hand, suggested that children learned more vocabulary in classrooms where teachers used more complex syntax. They argued that syntax may be an important source of linguistic information for young learners and an overlooked but potentially malleable dimension of teacher talk quality. It may be that children need a certain level of word knowledge and syntactic comprehension to make use of the word meaning information embedded in syntactically more complex utterances, and that young learners in a second-language context have not yet developed the language skills needed to benefit from complex utterances. Contrary to this argument is however Gámez et al.'s (2017) conclusion that teachers' syntactic complexity positively predicted vocabulary in both monolingual and bilingual learners studied longitudinally from fall to spring term in kindergarten. Perhaps teachers use more complex syntax to explain interrelationships among ideas and clarify the meaning of words in ways that single-clause utterances cannot. For example, the teacher in Example 2 above explained the phrase 'run out of money' using 2 single-clause utterances, saying 'To have no money. The wallet becomes empty.' The teacher in Example 3 explained a feeling associated with running out of money by using a 3-clause utterance, saying that 'I am afraid that if I do not have money then I cannot buy any food'. The results of the present study align with the conclusions in Farrow et al. and Gamez et al., that teachers with more complex syntactic utterances supported more nuanced ways of talking about the world in ways that deepened children's word comprehension. Supporting this argument is that, across both intervention and control groups, teachers' use of multi-clause utterances was associated with BPVS-2 outcomes over the preschool year.

Child syntactic comprehension outcomes were not related to the features of the teacher talk we analyzed, in contrast to findings in Hoff-Ginsberg (1986), Justice et al., (2013) and Huttenlocher et al. (2002). Possible explanations for this divergence may be related to how syntactic complexity was measured. Hoff-Ginsberg assessed mothers' syntactic complexity in talk to their 2-year-olds as MLU and number of verb and noun phrases per utterance. Huttenlocher et al. in a study of parental talk to 4-year old children demonstrated a significant relationship between parental syntactic complexity (the proportion of multi-clause utterances and whether sentences included coordinate clauses, relative clauses, or complement clauses) and children's mastery of multi-clause utterances. They similarly identified significant relationships between teachers' syntactically complex speech in preschool classrooms and children's syntactic comprehension growth over 1 year. Elaborating on Huttenlocher et al., Justice et al. (2013) characterized preschool teachers' complex syntax as marked by 2 or more clauses per utterance in teacher-child conversations. Teachers' use of complex syntax increased the likelihood that the children's responses would demonstrate complex syntax, and vice versa, with these associations varying across individual classrooms. Though the Extend intervention improved child syntactic comprehension (Grøver et al., 2020) and though the intervention teachers also produced more multi-clause utterances, we found no mediation effect of teacher talk quality as defined in this study for syntax outcomes. Our syntactic-complexity indicator, ratio of teacher utterances that included 4 or more clauses, indexed a syntactically rare type of teacher utterances. Future research should further develop syntactic-complexity measures beyond proportion of a defined set of clauses and identify effects of being exposed to clausing in various sentence constellations (independent clauses, relative clauses, etc.) that may further detail the syntactic complexity children are exposed to. Particularly, extending results from Gámez and Lesaux (2012) and Justice et al. (2013), it is of interest to identify the effects of syntactic complexity for DLLs with varying language skills. What is developmentally beneficial for DLLs with more advanced second-language skills may not be similarly supportive for children with less developed skills.

4.3. Limitations and conclusion

Mediation analysis assumes that the mediator is not caused by the outcome. However, a source of bias in the mediational chain is feedback; children's language may have impacted teacher talk. Teachers who have children with more advanced skills may use more complex language, as demonstrated in the Justice et al. (2013) study that also found that classrooms varied in the extent to which teachers' and children's interactions were syntactically adjusted to one other. The mediation effect on vocabulary may reflect the influence of child language sophistication on teacher talk quality rather than a teacher effect on children's vocabulary. Similarly, the lack of a mediation effect on syntactic comprehension may reflect an utterance-by-utterance adjustment to syntactic complexity in some classrooms and not in others. That we cannot control for the bi-directional nature of teacher-child interaction is a potential limitation in this study of indirect effects of teacher talk quality.

Another limitation is cluster sample size and intervention dosage. Schochet (2011) suggested that most school-based randomized controlled trials in education typically do not have sufficient power for conducting analyses to estimate associations between teacher practice mediators and student gain scores. Intervention children attended on average about half of the planned shared readings, and the variation in child attendance between classrooms was large, something that might explain why teacher talk quality did not mediate syntactic comprehension outcomes. The duration of the intervention is another factor to consider. Pre- and post-assessments of the children's vocabulary and grammar skills occurred 7–8 months apart. Hindman and Wasik (2012) showed that though 1 year of coaching was linked to gains in the ways teachers organized their classroom environments and in the quality of their instructional interactions, a second year of coaching was needed to produce gains in children's vocabulary outcomes. They suggested that in particular instructional interaction may take time to change due to the routine nature of ways teachers interact with children and the demands of everyday life that make it hard to alter talk quality. The Extend intervention, developed to support DLL's language learning, included a small home-based component during which families shared books in their preferred language. The children might have received support from the home reading in addition to the school-based reading, but our methodological design does not allow us to differentiate the potential impact of home reading from school reading on children's second language vocabulary and grammar outcomes.

Finally, we analyzed word diversity and multi-clause utterances as indicators of talk quality. Several studies have suggested that interventions based on professional development are particularly

successful when it comes to impacting teachers' communication-facilitating strategies but not lexical or grammatical details of their language use (e.g. Piasta et al., 2012). Wasik et al. (2006) and Dickinson and Smith (1994) found for example that teachers' questions before and after shared reading and their skills in building connections between what occurred during book reading and other classroom activities helped children construct a conceptual base for vocabulary development and provided opportunities for them to be exposed to and use more low-frequency words. We have not examined the extent to which teacher support for child participation during shared reading impacted child outcomes (see e.g. Cabell et al., 2015; Dickinson & Caswell, 2007). It is worth noting that children in the intervention group participated more during shared reading than their control group peers (assessed as number of child types and ratio of child utterances to total utterances). Teacher support for child participation would be a candidate for future research on teacher talk quality.

In spite of limitations, our findings have important implications for practice. First, professional development can facilitate the ways teachers share books with children, supporting teachers in offering a more diverse vocabulary, more spontaneous word explanations and multi-clause utterances; the fact that these qualities of teacher talk mediated part of the intervention effect on children's vocabulary strengthens the argument for focusing on them during professional development. Second, this study confirms the need for professional development and intervention designs that are specific to the local cultural and linguistic situation. The teachers in this study all served highly multilingual classrooms in which on average 2 out of 3 children spoke a family language different from the majority language Norwegian, but also did not most share a first language with one another. This situation requires a different intervention design than, for example, the more frequent U.S. situation where one immigrant language dominates in many DLL-serving classrooms. Though not in the focus of the present analysis, the intervention component that included sending home books that were read in preschool with the request that parents share them in their preferred language, may suggest one direction for dual-language supportive work with parents in linguistically diverse neighborhoods. Furthermore, the Norwegian play-based model of early childhood education precludes heavily scripted learning activities, in contrast to common practices in the U.S. Nonetheless, it was possible to design a culturally adapted intervention that supported teachers to read interactively in ways that promoted children's vocabulary learning. The intervention was evidently successful in overcoming a common tendency of teachers of DLLs to reduce lexical diversity and syntactic complexity, thus perhaps providing impoverished input to children learning a second language (Aarts et al., 2016). Participating teachers incidentally told us that that they had learned not to simplify the themes they discussed with their children, even the beginning speakers of Norwegian. An implication is that teachers who work with DLLs may be supported to attend to the diverse perspectives embedded in children's literature and to children's knowledge and interests during interactive reading, and to do this in ways that expose children to the sophisticated vocabulary and syntax that is needed to cover such topics in nuanced ways.

This study opens up many avenues for future research. With the available sample we could not easily explore whether differences in child outcomes were more related to teacher characteristics, to family demographics, or to children's initial language levels in either Norwegian or the home language. In this study, there was a small family component; exploring whether more robust family involvement is feasible and/or effective would certainly be of value (see, e.g., Castro et al., 2011). Factors that might help explain differences in teacher uptake of newly introduced shared-reading practices deserve further study, and so do follow-up studies to explore whether observed differences in teacher practices and child outcomes persist after the completion of the intervention study.

Declaration of competing interest

None

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