The role of the environmental context in shaping teachers' linguistic input

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Abstract: While decades of research have demonstrated that the quality of linguistic input children receive from adults has significant effects on their language development, more recent work suggests that the quality of that input is affected by the environmental context in which it is delivered. In the current study, six teachers were audio-recorded teaching four- and five-year-old children similar content in either a museum, their classroom with museum resources, or their classroom with typical classroom resources. Quality of input was measured in terms of the proportion of decontextualised talk, *wh-* questions, rare words and multi-clausal sentences produced. Teachers produced a significantly higher proportion of decontextualised talk when teaching in the museum compared to teaching in the classroom with regular classroom resources. However, teachers used the highest proportion of rare words when teaching with museum resources in the classroom compared to the other two contexts. These data demonstrate that different learning contexts lend themselves to different aspects of high-quality input, with implications for children's language development.

Keywords: linguistic input; context; learning environment; museum; classroom

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Introduction

In recent decades, extensive research has been dedicated to uncovering the factors which may affect the rate at which children successfully acquire the necessary language skills to thrive. A critical factor is the linguistic input children receive, and its profound effect on children's early language development has been repeatedly demonstrated (e.g., Hart & Risley, 1995; Hoff-Ginsberg, 1985; Huttenlocher et al., 2002; Rowe, 2017). Importantly, many studies have demonstrated that quality, not just quantity, of linguistic input plays a key role (e.g. Rowe, 2012). Importantly, however, recent work has demonstrated that the environmental context linguistic input is received in can also affect language learning (Lester, Theakston & Twomey, 2023; Tamis-LeMonda et al., 2019). However, while the focus of research has largely been on parental language, a substantial amount of language input to school-age children comes from their teachers. Thus, in the present exploratory study, we examined whether there was a relationship between the quality of linguistic input children receive from their teachers and the context in which they receive it, with a particular focus on museum contexts and teaching resources. Below, we review existing evidence demonstrating the importance of language input for language development and discuss the effects of input quality (the richness and complexity of the language children hear) on early acquisition.

Linguistic Input from Caregivers

An extensive body of research has shown that language development in children is influenced by the linguistic input that they receive. There is now a consensus that a rich input, in terms of quantity, diversity, and complexity, promotes language development and leads to more rapid language acquisition (Hoff & Naigles, 2002; Rowe, 2008). Much previous research on the effects of linguistic input has focused on the sheer quantity of words (word tokens) heard by children and suggests this is positively correlated with vocabulary growth (Hart & Risley, 1995; Huttenlocher et al., 1991). However, recent years have seen a growing interest in the role of quality in linguistic input. Previous studies have defined input quality in a variety of ways, uncovering positive relationships between linguistic quality and children's language development across a range of language areas and stages of development (e.g. Blything et al., 2019; Huttenlocher et al., 2002; Rowe, 2012; Salo et al., 2016; Uccelli et al., 2019; Weizman & Snow, 2001).

For instance, there is accumulating evidence that the number of open-ended questions addressed to children is positively related to their language development (Hoff-Ginsberg, 1985; Rowe et al., 2017; Shatz et al., 1989). Open-ended questions, often characterised as *wh-* questions—that is, questions that begin with who, what, where, when, why or how—are thought to provoke more thoughtful and sophisticated responses compared to closed questions which require a simple yes or no answer (Ping,

2014). Moreover, when children attend to non-verbal environmental cues such as their caregiver's eye-gaze or potential referents of new words whilst simultaneously being exposed to *wh-* questions, they are given the opportunity to practice linking referents to objects. In particular, even in cases where children do not know the answer to a question, they are able to use both the question and non-verbal cues to determine the answer, thus developing their verbal reasoning skills (Rowe et al., 2017). Increased parental use of *wh-* questions has been positively related to children's auxiliary verb usage (Hoff-Ginsberg, 1985), vocabulary size (Blake et al., 2006; Rowe et al., 2017; Salo et al., 2016) and better verbal reasoning skills (Rowe et al., 2017). This growing body of evidence highlights the importance of *wh-* questions in linguistic input, and their role in developing and enhancing the language skills of the young language learner.

However, other research highlights the importance of alternative facets of input quality. In particular, an increasing number of studies show that parents' use of decontextualised talk positively enhances children's language acquisition (Gillam et al., 2012; Rowe, 2013; Rowe, 2012). Decontextualised talk is defined as language used to discuss absent objects or events occurring in the past or future (Snow, 1990), and often takes place when speakers are engaged in narrative, explanatory or pretend discussion (Snow et al., 2001). Decontextualised talk is considered more conceptually complex than contextualised talk, as children cannot rely on the visual context for comprehension, and it often includes more sophisticated vocabulary (Rowe, 2013). The proportion of decontextualised talk in linguistic input is positively related to children's later vocabulary, narrative comprehension and production (Beals, 1997; Katz, 2001; Reese et al., 2010; Snow et al., 2001), reading comprehension (Snow et al., 2001) and ability to provide formal definitions (Katz, 2001), skills that are essential to children's literacy development (Cunningham & Stanovich, 1997). Specifically, Rowe (2012) found that four-year-old children who were exposed to a higher proportion of parental decontextualised talk, particularly narrative utterances, had larger vocabularies one year later compared to those who heard less decontextualised talk. Rowe suggested that by exposing their children to narrative about topics that are removed from the present, parents challenge children to think abstractly and scaffold their child's ability to produce similar discourse, thus promoting their child's vocabulary development.

In addition to exploring the effects of decontextualised talk, Rowe (2012) also found that the proportion of sophisticated vocabulary (defined as words not commonly known by children aged 9-10 years) used by parents with their 30-month-old children was a stronger predictor of children's vocabulary size one year later than the quantity of talk that children were exposed to. Rowe argues that by this age, children have had substantial exposure to commonly used words and are ready to acquire more difficult and sophisticated vocabulary. Thus, sophisticated vocabulary is more beneficial to children of this age in terms of vocabulary size than sheer quantity of talk. Similarly, Weizman and Snow (2001) found that the proportion of sophisticated words heard by

5-year-old children during interactions with their mother's predicted variance in vocabulary skill during their first and third year of school (see also Beals, 1997).

Linguistic Input in Childcare or School Settings

Much of the existing research focuses on the quality of the linguistic input children receive from their primary caregivers who are often a child's initial source of input (although largely in WEIRD [Western, Educated, Industrialised, Rich and Democratic] cultures). However, as soon as children start full-time education, linguistic input from teachers constitutes a significant proportion of the language they hear: children spend an average of 32.5 hours a week in a typical UK classroom over the course of an academic school year (Department for Education, 2022). Consequently, researchers have begun to recognise that a significant proportion of a child's linguistic input may come from within their childcare setting or school, and that there is a consequent need to understand the nature of this input and its effects on language development. Studies focusing on the nature of the input children receive from teachers participating in normal teaching or classroom-based conversational activities have shown that when children receive high quality input from teachers (specifically, a higher proportion of multi-clausal sentences, decontextualised talk, and use of more varied word types), their communication skills, language development, and reading abilities accelerate (e.g., Bowers & Vasilyeva, 2011; Dickinson & Porche, 2011a; Huttenlocher et al., 2002). For instance, Huttenlocher et al. (2002) found that the quality of teachers' linguistic input to three- to four-year-old children was positively related to the children's syntactic development; when teachers used a higher proportion of multi-clausal sentences, children's comprehension of these structures increased over the school year. In addition, lexical richness – that is, the number of different word types used by teachers – predicted children's vocabulary growth (Bowers & Vasilyeva, 2011), and teachers' use of decontextualised talk has been found to have similar positive effects on children's vocabulary production and comprehension (De Temple & Snow, 2003; Mascareño et al., 2016). These effects have been found to last beyond early primary school (Burchinal et al., 2008; Dickinson & Porche, 2011a; Mashburn et al., 2009) and have also been observed in pre-school contexts where the language of education was different from the children's home language (Gámez, 2015, see also Bowers and Vasilyeva, 2011).

Linguistic Input and Context

So far, we have discussed evidence that the quality of the linguistic input provided by teachers in normal classroom interactions and during book reading activities can have a positive impact on children's language development. However, the linguistic input children receive, and thus the quality of that input, can be affected by the context in which it is provided. Again, the vast majority of research on how linguistic input differs between contexts focuses on the input provided by primary caregivers

(e.g., Noble et al., 2018; Tamis-LeMonda et al., 2017; Tamis-LeMonda et al., 2019). However, there is a handful of studies that compare teacher input across contexts, to begin to address this gap in the literature (e.g., Chaparro-Moreno et al., 2022; Cote, 2001; Massey et al., 2008). For instance, differences in teachers' linguistic input have been found between different activities in the classroom. In a corpus analysis of 2,928 utterances in 453 conversations that 13 preschool children had with peers and teachers during a typical school week, Chaparro-Moreno and colleagues (2022) found that in activities that were mainly led by teachers such as circle time (whole class discussion) and reading, teachers used more decontextualised talk compared to activities such as centre time, where children move around more freely and have more autonomy over their interactions. Similarly, Farrow, Wasik and Hindman (2020) found that teachers used more complex sentences during book reading, compared to the 'morning message' or other small group activities. Further, Cote (2001) found different patterns in teachers' and children's use of sophisticated vocabulary in different learning contexts. Children used significantly more sophisticated vocabulary during circle time compared to book reading, mealtime, and free play. In contrast, teachers used significantly more sophisticated vocabulary during free play than at mealtime, and significantly less during book reading than mealtime (excluding the words from the book itself in the analysis).

Gest et al. (2006) explored how teachers' linguistic input differed across book reading, free play and mealtime contexts with three- and four-year-old children from 20 Head-Start classrooms in the USA. They found that teachers provided the highest rate of rich and complex child-directed talk (in terms of the variety of vocabulary, the proportion of extended, elaborated utterances, and the introduction of new concepts, ideas and information) during book reading, a finding they suggested was due to the new and varied language teachers used when asking and answering questions about a new book. In contrast, teachers provided the highest rate of pretend talk in the free play context, as they often assumed the role of play enhancer, encouraging pretend and imaginative play amongst children. Teachers used less rich and challenging talk, but more decontextualised talk at mealtimes compared to the book reading and free play contexts, which likely reflected the standard mealtime etiquette.

There is some evidence from more detailed studies of book reading in classrooms to suggest that these aspects of teacher input quality translate to children's vocabulary acquisition. For example, several studies show that providing explicit definitions of target words during book reading activities is positively related to pre-school and reception-aged children's receptive and expressive vocabulary growth (Beck & McKeown, 2007; Coyne et al., 2009; Gonzalez et al., 2010; Hadley et al., 2016; Wasik et al., 2016). There is also substantial evidence to suggest that incorporating questions into book-reading interventions is beneficial to word learning (Dickinson & Porche, 2011b; Dickinson & Smith, 1994; Sénéchal, 1997). For example, Sénéchal (1997) found that three- and four-year-old children's expressive and receptive vocabulary gains were

greater when teachers incorporated 'what' or 'where' questions into their book-reading activities, compared to when teachers focused solely on producing the words contained in the book, and in a study with 14 teachers and their teaching assistants in their classrooms with their 4-year-old students, Massey and colleagues (2008) found that teachers used more cognitively challenging questions during shared book reading, compared to any other classroom activity. Cognitively challenging questions were defined as those that were conceptually focused (i.e., focused on non-present objects or past and future events) and included eliciting inferences or predictions, analysing information, and discussing vocabulary in this study.

Importantly, although much of the linguistic input from teachers is provided in the context of formally taught lessons in a classroom environment, this is not always the case (Barnes et al., 2020). Although this body of literature goes some way to uncovering how linguistic input from teachers differs between different classroom-based activities, to-date, few studies have explored whether delivering teaching outside of the classroom environment has any effect on the quality of the linguistic input children receive. In particular, museums are a popular destination for school trips and may offer enhanced learning experiences for children (Henderson & Atencio, 2007). Indeed, some researchers have suggested that information-rich museum environments provide an ideal learning context to promote language learning in young children (Henderson & Atencio, 2007; Kola-Olusanya, 2005; Rodriguez & Tamis-LeMonda, 2011). Henderson and Atencio (2007) proposed that museums' attractive exhibits and the presentation of open-ended questions promote conversation amongst visitors, and encourage children to actively explore their environment, thus creating language learning opportunities. One possibility is that museums are contexts that encourage caregiver/teacher language input that is high in quality, for example by promoting the use of rare words, *wh-* questions and decontextualised talk. It is therefore important to understand how different educational contexts, that is, different environments/locations and/or teaching resources and activities, may affect the linguistic input that teachers provide.

The Present Study

In the present study we aim to close this gap in the literature by exploring whether the quality of the linguistic input teachers provide differs when delivering the same learning activity (a) in a classroom with regular classroom resources (b) in classroom with museum resources, and (c) in a museum context with access to a wider variety of resources such as exhibits, information signs, and knowledgeable staff. In line with previous research, we chose to measure language quality in a variety of ways that have previously been found to enhance children's language development. Specifically, we asked whether the proportion of *wh-* questions, utterances containing decontextualised talk, multiclausal sentences and rare words used by teachers differed between contexts.

Although previous work suggests that there could be effects of context on linguistic input, the present study is exploratory in nature, aiming to highlight what these effects may be. Classroom-based teaching shows differences in the quality of input as a function of the learning activity (e.g., Chaparro-Moreno et al., 2022; Gest et al., 2006; Massey et al., 2008), though it is unclear whether this is affected by the types of classroom resources used in any given activity. Moreover, while classroom resources often include books which promote quality talk (e.g. Cameron-Faulkner & Noble, 2013; Wasik et al., 2016), museums provide enriched visual, unique learning contexts which could promote more decontextualised talk (e.g., Kola-Olusanya, 2005). Thus, for the current study, we do not make any directional hypotheses concerning which contexts might promote different types of high-quality input.

Method

Participants

Our sample consisted of six female teachers all of whom taught reception-aged children [4-5 years] at an inner-city primary school in the North West of England, UK, with a majority of pupils learning English as an additional language. Participants were recruited through a partnership between the school where they worked, a local museum and a university, and took part on a voluntary basis. Participants provided informed, written consent prior to taking part in the study. Participants were between the ages of 21-44 years. Participants had an average of 11.5 years' teaching experience (SD = 4.68). Five participants were monolingual English-speaking, and one participant was a bilingual English and Urdu speaker. English was the first language of all participants, and all teaching was delivered in English.

Procedure

Each session was delivered to a unique group of 11 to 14 children from the year group, with no child participating in more than one session. A single teacher led each session, although individual teachers delivered multiple sessions across different groups as indicated below. Due to Covid-19 and the associated restrictions, half of the sessions were taught prior to the Covid-19 outbreak with the 2019 Reception cohort of children, and half of the sessions were taught post-Covid-19 outbreak with the 2020 Reception cohort. Due to one failed recording, the final dataset consisted of 11 recorded sessions - three in the museum, three in the classroom with museum resources, and five in the classroom with regular classroom resources (see Table 1). For the two teachers who taught in both the museum context and the classroom with regular classroom resources context, one taught in the museum first, followed by the classroom with regular classroom resources, and the other taught in the classroom with regular classroom resources first, followed by the museum. For the three teachers

who taught post-COVID-19 pandemic, two taught in the classroom with museum resources first, followed by the classroom with regular classroom resources, and the other teacher taught in the classroom with regular classroom resources first, followed by the classroom with museum resources.

Table 1. ***Number of sessions taught in each context by participant.***

Participant	Number of sessions taught in each context		
	Museum	Classroom with museum resources	Classroom with regular classroom resources
Teacher 1	1	0	0
Teacher 2	1	2	1
Teacher 3	1	0	1
Teacher 4	0	0	1
Teacher 5	0	1	1
Teacher 6	0	1	1

All teaching sessions pre-Covid-19 were taught over the course of three consecutive days; thus, the teachers who taught their sessions prior to the COVID-19 pandemic taught their second session either one day or two days after teaching their first session. All teaching sessions post-Covid-19 were taught over two consecutive days meaning teachers taught their second session the day after teaching their first. Teacher 2 taught four sessions in total as she had a class of children in the target year group both pre-Covid-19 and post-Covid-19. Teachers were unaware of the purpose of the study until they were debriefed at the end, and the lead researcher was present during all teaching sessions, though they were not directly involved with the session.

All teaching sessions were themed around the topic of insects, and the central goal of all sessions for all teachers was to teach children six novel vocabulary items (names of insects). The researcher (first author) instructed each teacher to spend approximately 20 minutes per session teaching these vocabulary items using the resources available in each context. While teachers were given flexibility in how they used the resources, they independently chose to use them in very similar ways across the three contexts. When teaching in the museum, teachers could use the insect displays in the exhibit: boxed specimens of each of the target insects that had been preserved for educational purposes, small plastic magnifying glasses, and a microscope. When teaching in the classroom using museum resources, teachers used the boxed specimens from the museum. When teaching in the classroom using standard classroom resources, teachers used coloured, laminated images of insects, and a book titled Everything Insects by Carrie Gleason (produced as part of the National Geographic for Kids range). The six participants collectively agreed prior to the beginning of the

study that these resources reflected those that they would typically use in the classroom. Teachers were told they were free to use the resources in a way that reflected their individual teaching style, which ensured conditions were as natural as possible whilst controlling the materials used. Each taught session lasted approximately 20 minutes. Teachers were audio recorded using an Olympus DS-3500 digital voice recorder worn on a lanyard around their neck.

Transcription

All recordings were transcribed by the lead researcher verbatim in English using CLAN (MacWhinney, 2000). Only the teachers' speech was transcribed – any audible child speech was omitted. The flow of teacher speech was divided into utterances. We defined 'utterance' as having a single intonational contour within a single conversational turn and consisting of one or more syntactic units (e.g., constituents or clauses). An utterance was usually preceded and followed by a pause (Huttenlocher et al., 2010). A second coder transcribed a random 10% of the recordings. Agreement on exact wording and the breakdown of speech into utterances averaged 92% (range = 85% - 97%).

Analysis of speech

Transcripts were coded and analysed by the first author. No transcribed utterances were excluded from the analysis. Transcriptions were coded for quality of teacher talk. Specifically, in order to measure quality, transcriptions were coded for utterances containing *wh-* questions, decontextualised talk, multi-clausal sentences and rare word vocabulary (a measure of lexical richness), as defined in the coding scheme below. Finally, we performed between-setting comparisons for each measure.

Coding Scheme:

We created a coding scheme based on those previously used by Gest et al. (2006), Huttenlocher et al. (2002; 2010), Noble et al. (2018), Rowe (2012), and Snow et al. (2001). For our measures of *wh-* questions, decontextualised talk and multi-clausal sentences, we coded every utterance spoken by teachers as either containing each of the variables of interest (coded 1) or not (coded 0) to enable analyses to be conducted on the proportion of use of each measure as a function of the overall number of utterances produced. For our rare words measure, it was necessary to collapse the data across participants and teaching sessions to determine the total proportion of rare words used in each context (i.e. total rare words used per context / total words used per context). These measures were defined in the following ways:

***Wh*-Questions:** utterances transcribed with a question mark and having *wh-* question syntax in the main clause- who, what, where, why, when and how (e.g.

"What can you see?" "Where are its wings?").

Decontextualised Talk. talk about people, places, things, and events that that happened in the past or will happen in the future (Gest et al., 2006; Rowe, 2012) (e.g. "There was one of these in my garden once" "I was bitten by one of these on holiday"). Talk about events that took place just minutes before but were no longer taking place in the present moment were also treated as decontextualised talk (e.g. "We've just looked at the beetles."). This is consistent with other definitions in the literature, such that decontextualised talk can encompass either a spatial or a temporal detachment from immediate context (Snow et al., 2001). Spatially detached talk encompassed any references to things not immediately present. This includes discussions about people or places that are not physically there (Gest et al., 2006), interpretations of others' intentions or mental states (DeTemple, 2001), and abstract language use such as offering definitions and explanations of concepts that cannot be directly observed (Rowe, 2012).

Multi-Clausal Utterances. utterances containing more than one clause (e.g. "Have a look inside the box and then pass it on."). Additionally, utterances that contain more than one lexical verb were coded as multi-clausal (e.g. "she sat and listened carefully.").

Rare Words. Word tokens with a Log Zipf Frequency of three or below on the Subtlex database (van Heuven et al., 2014) were considered rare. The Subtlex-UK word frequencies are based on a corpus of 201.3 million words from 45,099 BBC broadcasts. There are separate measures for primary school children (the CBBC channel), which was the measure used for the present study; van Heuven et al. also present the word frequencies as Zipf-values (values 1-3 = low frequency words; 4-7 = high frequency words).

Reliability of Coding:

Across all transcripts, there was a total of 4,879 utterances. A second coder coded a random selection of 10% of the transcripts. Agreement when coding *wh-* questions was 98.2% with a Cohen's kappa value of 0.92. Agreement when coding for decontextualised talk was 93.3% with a Cohen's kappa value of 0.66, and agreement when coding for multi-clausal sentences was 93.5% with a Cohen's kappa value of 0.58. As only a subset of the data was coded for reliability, no changes were made to the coding where disagreements occurred. Rare words were coded automatically against the SUBTLEX database using (version 4.1.1; R Core Team, 2021).

Results

Across the three 20-minute recordings in the museum, there was a mean of 490 utterances per recording (range: 424-549). Specifically, there was a mean of 433 utterances across the five 20-minute recordings in the classroom with classroom resources (range: 372-475), and a mean of 438 utterances across the three recordings in the classroom with museum resources (range: 302-585). Analyses of input quality measures between contexts were carried out using the lme4 package (Bates, Maechler, Bolker, & Walker, 2021) to fit generalised linear mixed effects models for the proportion of utterances containing *wh-* questions, decontextualised talk and multiclausal sentences in R (R Development Core Team, 2021). Restricted maximum likelihood estimation was used for the reporting of generalised linear mixed model parameters. We tested if the inclusion of an additional term was justified using the likelihood ratio test for model comparisons (Pinheiro & Bates, 2000). The factor 'Context' was coded using treatment contrast (the default coding in R), with the reference level 'Classroom Resources'.

Table 2 reports the mean proportions and standard deviations of each measure of quality in each context. Each measure of linguistic quality occurs, on average, in only a small proportion of utterances (6-12%). We were interested in whether the quality of the linguistic input teachers used differed between the contexts in which they taught. First, the three binary outcome variables (*wh-* questions, decontextualised talk and multi-clausal sentences) were submitted to separate generalised linear mixed effects models with fixed effects of context (museum, classroom with classroom resources, classroom with museum resources), with a random intercept for participant. This random intercept was included to account for any individual differences amongst teachers given the fact that not all teachers taught in all contexts, and the fact that the combination of contexts in which they taught differed. Pairwise comparisons were then run using the Emmeans package with Bonferroni correction to determine exactly where the differences in linguistic input between each context lay (Lenth et al., 2023).

Table 2. ***Mean proportions and standard deviations by variable and context (and proportion of rare words).***

Context	*wh-* Questions		Decontextualised Talk		Multi-Clausal Sentences		Rare Words	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Museum	0.09	0.04	0.11	0.02	0.11	0.03	0.01	0.09
Museum Resources	0.09	0.04	0.10	0.04	0.10	0.05	0.05	0.21
Classroom Resources	0.09	0.03	0.07	0.02	0.07	0.01	0.02	0.15

The first analysis did not find a significant effect of context on the proportion of *wh*-questions teachers used. Compared to the reference level context (classroom resources), teachers were not significantly more likely to produce *wh-* questions in the museum context (β =0.11, *SE* = 0.14, *z* = 0.77, *p* = .44), or in the museum resources context (β = −0.22, *SE* = 0.12, *z* = –1.81, *p* = .07). The model explained a very small amount of variance, with a marginal R^2 of 0.005 and a conditional R^2 of 0.05, indicating that fixed effects alone explained little variance and random effects contributed only modestly to the overall variance. A chi-squared comparison showed that a null model containing only the random effect of participant, did not statistically differ from a model that contained the fixed effect of context ($\chi^2(2) = 4.51$, $p = .11$).

A second analysis indicated that context significantly influenced the likelihood of decontextualised talk. Compared to the classroom resources context, teachers were significantly more likely to use decontextualised talk in the museum context (β = 0.26, *SE* = 0.12, *z* = 2.20, *p* = .028), but less likely to use decontextualised talk in the museum resources context (β = −0.37, *SE* = 0.13, *z* = –2.83, *p* = .0047). Although the effect was statistically significant, the beta coefficient was small, indicating that the size of the effect was modest, and indeed, the mean values across contexts ranged from 6-12% indicating that decontextualised talk was relatively rare in all contexts. This suggests that while context has a measurable influence on the likelihood of decontextualised talk, the practical impact may be limited. Moreover, the model explained a small proportion of variance overall, with a marginal R^2 of 0.01 and a conditional R^2 of 0.02, indicating that fixed and random effects contributed modestly to explaining variation in decontextualised talk.

Bonferroni-adjusted pairwise comparisons revealed that decontextualised talk differed significantly between the museum and museum resources contexts ($p < .001$), while the difference between classroom resources and museum resources was also significant ($p = .014$). However, the difference between classroom resources and museum did not reach statistical significance after correction ($p = .083$).

Additionally, a GLMM revealed a significant effect of context on the proportion of multiclausal utterances in teacher's linguistic input. Specifically, teachers were significantly more likely to produce multiclausal utterances in the museum resources context compared to the classroom resources context (β = 0.49, *SE* = 0.15, *z* = 3.26, *p* = .001). However, the difference between the museum and classroom resources contexts was not significant (β = 0.04, *SE* = 0.16, *z* = 0.25, *p* = .80). Post Hoc comparisons indicated that the proportion of multiclausal utterances was highest in the museum resources context (*M* = –2.07, *SE* = 0.18), followed by the museum (*M* =−2.52, *SE* = 0.18), and lowest in the classroom resources (*M* = −2.56, *SE* = 0.16). Bonferroni-adjusted pairwise comparisons showed that the museum resources context had significantly more multiclausal utterances than the classroom resources context (*p* =.003).

However, on average only 7-11% of utterances across contexts were multiclausal, and while significant, the β values were again relatively small, suggesting that other factors may play a more substantial role in explaining variance in the proportion of multiclausal utterances. The difference between the museum and museum resources contexts approached significance ($p = .052$), while the classroom resources–museum contrast was not significant ($p = 1.00$). Overall, the model explained a modest proportion of variance, with a marginal R^2 of 0.01 and a conditional R^2 of 0.04, indicating that fixed and random effects together accounted for a small amount of the variability in multiclausal utterance production.

To examine the relation between context and the teachers' use of rare versus non-rare words in their linguistic input, a chi-square test of independence was performed. As this measure was taken at the level of a full teaching session rather than on an utterance-by-utterance basis (because each utterance contained multiple different words), it was necessary to collapse the data across participants and teaching sessions to determine the proportional use of rare words in each context. The relation between these variables was significant, $\chi^2(2, N = 6) = 221.8$, $p < .01$. Teachers used the highest proportion of rare words when teaching in the classroom with museum resources, and the lowest proportion of rare words when teaching in the museum.

It was necessary to pause data collection for the present study due to the Covid-19 pandemic, resulting in all data from the museum and half of the classroom resources data being collected prior to the pandemic, with the remainder data being collected post-pandemic. Thus, it was essential to check whether taking part in the study prior to or post the first UK government lockdown significantly affected the quality of teachers' linguistic input, as this could mean that any differences found between contexts reflected unexpected effects of the pandemic rather than effects of the contexts themselves; for example, teachers may have been conscious of the need to alter their input post-pandemic as children had missed in-person school time. We found that taking part in the study prior to or post Covid-19, measured through the addition of a 'Covid' variable (pre-Covid, post-Covid) to the models, had no significant effect on the proportion of utterances containing *wh-* questions ($\chi^2(1) = 0.52$, $p = .47$) or decontextualised talk ($\chi^2(1) = 0.05$, $p = .82$) produced by teachers. However, when teachers took part in the study pre-Covid, they produced significantly fewer multi-clausal utterances compared to taking part in the study post-Covid ($\chi^2(1) = 9.12$, $p = .003$). The addition of the Covid variable to the model containing the fixed effect of multi-clausal sentences meant that the beta value for the fixed effect of context on this variable in the model was no longer significant, suggesting the two variables account for some of the same variance.

General Discussion

The present study explored whether the context in which teachers taught children

affected the quality of their linguistic input. For the purposes of this study, a change in context in an environmental sense referred to a change in either the physical environment, the teaching resources, or both (but not a change to the content of the teaching session). Quality of linguistic input was assessed according to the proportional use of utterances containing *wh-* questions, decontextualised talk, multi-clausal sentences, and the proportion of rare words used in each teaching session. Teachers taught groups of four- and five-year-old children either in the museum, in their regular classroom setting with regular classroom resources, or in their regular classroom with resources from the museum. Our findings show that some aspects of teachers' linguistic input were affected by teaching context, thus underscoring its potential importance when considering the promotion of language development in children. Specifically, the frequency of teachers' utterances containing decontextualised talk significantly increased when teaching in the museum compared to teaching in the classroom with museum resources and teaching in the classroom with regular classroom resources. The frequency of rare words used by teachers was significantly higher when teaching in the classroom with museum resources and was lowest when teaching in the museum. In addition, the use of multi-clausal sentences increased when teachers taught in the classroom with museum resources, compared to teaching in the museum, or teaching in the classroom with regular classroom resources, though this was no longer significant when participation in the study prior to or post-Covid-19 was taken into account. There were no significant contextual effects on teachers' proportional use of wh- questions. These findings both support and extend those of previous work, showing that the linguistic input provided by teachers differs across contexts, but demonstrate that these effects are not just present due to the task itself, but also the environmental context in which children are taught. Below, we discuss possible explanations for the differences in the quality of input in the different contexts.

Decontextualised Talk in the Museum

It could be that being in a novel museum environment compared to their normal classroom environment provided teachers with greater opportunity to discuss non-present events. Teachers were inclined to discuss previous museum trips with children and related the museum resources back to events that had taken place in school (e.g. "when we do our minibeast hunt have you ever found one?"). Teachers also utilised the substantial array of objects, information boards and interactive displays around the museum exhibit to prompt discussion about non-present events (e.g. "you might have seen some mosquitoes before when you've been on holiday."; "maybe when we go back to class this afternoon, we can have a go at drawing a hornet."). These observations echo the findings of Tamis-LeMonda and colleagues (2019) who found that parental level of decontextualised talk was greater when engaged in object-play activities compared to other tasks such as grooming, feeding and transition, whilst also extending it to teachers in an educational capacity (for converging

evidence of an effect of context on both utterance complexity and amount of decontextualised talk, see Brinchmann et al., 2023).

Although the same core objects were used in the museum resources in the classroom condition, it could be that the novel environmental context of the museum coupled with the additional resources that it offers promoted teachers' decontextualised talk (e.g., "when I went on holiday I saw lots of mosquitos."). In contrast, because the objects themselves were novel and interesting in the museum resources condition compared to regular classroom resources, teachers focused their discussion on what the children could see in front of them and how they would describe the objects (e.g."what can you see?" "How many legs has it got?"), and less frequently diverted conversation towards non-present objects and events (e.g."maybe in the summer when we do a bug hunt we might find one"). Thus, novelty in learning environment promoting decontextualised talk in the museum, and novelty in the task reducing decontextualised talk in the classroom, may account for our finding that decontextualised talk was used significantly less often in the museum resources condition than in both the museum and classroom with classroom resources.

Importantly, this finding also provides some empirical support for the claims that museums make good language learning environments for young children (Henderson & Atencio, 2007; Kola-Olusanya, 2005; Rodriguez & Tamis-LeMonda, 2011). Specifically, the quality of linguistic input in terms of decontextualised talk was found to be greater in the museum context compared to the other two contexts, and importantly, the frequency of decontextualised talk in linguistic input is positively related to children's later vocabulary, narrative comprehension and production (Beals, 1997; Katz, 2001; Reese et al., 2010; Snow et al., 2001) and reading comprehension (Snow et al., 2001). Thus, museums may enhance language learning opportunities through the promotion of decontextualised talk.

Multi-Clausal Utterances

Like Gest and colleagues (2006), the present study also suggests that context affects the frequency of teachers' multi-clausal utterances. Teachers may have been more likely to use longer, elaborated utterances when using museum resources in the classroom, because the context allowed the task and discussion to be more in-depth and focused on the objects themselves (e.g. "so let's remember, this beetle is black and it's got six legs"; "it's definitely got lots of legs hasn't it?"). In contrast, being in the museum may have meant teachers paid additional attention to the novel environment. Previous research suggests that more structured contexts with focal tasks elicit higher quality linguistic input from caregivers (Tamis-LeMonda et al., 2017). Moreover, it could be that using regular resources in their normal classroom setting was not sufficient to promote long, elaborated discussion above and beyond using novel, more interesting resources. However, this finding should be interpreted with caution, as the

effect of context was difficult to disentangle from the effects of the Covid-19 pandemic. Interestingly, teachers produced significantly fewer multi-clausal utterances overall before the Covid-19 pandemic began. It could be that on returning to school after lockdown, teachers were aware that children had missed out on a large amount of their education, and that they played an important role in helping children catch up. Thus, they talked to children using longer, more elaborate utterances. Further research would be required to clarify if this suggestion is correct.

Rare Words

Our findings demonstrate that the frequency of rare words used by teachers varies across contexts, a finding that has not yet been investigated in previous research. We found that teachers used the highest proportion of rare words when teaching with museum resources in the classroom. One possibility is that using novel, interesting resources in a familiar environment enabled them to focus their input more on the resources, thus incorporating more rare words. Although the resources used in the museum were the same, we observed that less time was spent discussing these compared to in the classroom, as children were also given time to explore the museum exhibit. It seems that because less time was spent on the structured activity discussing the boxed specimens, and more time was spent freely exploring the environment, teachers' linguistic input was interspersed with more periods of 'off-topic' conversation, such as managing children's excitement and guiding them to the right areas. Teachers also answered children's generic questions, for example about exploring other areas of the museum ("no we're just looking at bugs today") or what time the bus was coming to collect them from the museum ("I know we're going to have lunch soon") compared to the classroom when using museum resources, therefore allowing less opportunity to incorporate rare words.

Wh-Questions and Context

Although our contexts showed differences in some measures of linguistic quality, we found no differences for *wh-* questions. This could be due to the focal task of the taught sessions being very similar in all contexts, with the only difference being the resources used. For example, teachers would tend to ask similar *wh-* questions in all contexts regardless of the resources, often alluding to what the children could see in front of them, or how they would describe the target items.

Future Directions and Testable Hypotheses

Our findings highlight some variation in the quality of teachers' linguistic input across different teaching contexts, with some contexts appearing to promote different dimensions of quality compared to others. Specifically, we observed more decontextualised talk in the museum context, while classrooms using museum resources

prompted more multi-clausal utterances and rare words. These findings offer a testable hypothesis for future work: that both physical context and teaching materials contribute, interactively or independently, to shaping teachers' linguistic input. Disentangling the relative contributions of these factors is important. For example, future studies could manipulate the materials used, while holding context constant, or vice versa, to determine whether particular features of the environment (e.g., novelty, authenticity, visual stimuli) or of the materials (e.g., conceptual richness, novelty, tangibility) are more influential in eliciting specific types of language from teachers. Additionally, given that we found different measures of quality were more prevalent in different contexts, this suggests that different features of the learning environment may selectively promote different aspects of quality in teachers' linguistic input. In light of this, a hypothesis that should be explored in future work is that there is no single "best" context for promoting high-quality input, but rather that diverse contexts may be suited differently to supporting particular linguistic goals. Future research should aim to identify which features of the learning environment most robustly promote which measures of input quality, and how these can be integrated into teacher training and curriculum design. This work will be critical for developing a more nuanced, theory-driven understanding of how teaching environments shape children's language learning opportunities.

Considerations and Conclusions

It is important to acknowledge that in the present study, the data were collected from a relatively small number of 20-minute teaching tasks per context, with only one set of resources being used in each context, and only a small number of teachers contributing data. Although we accounted for individual differences in teacher talk in our statistical models, and the number of utterances collected was high, it will be important to replicate these findings with a wider range of tasks and participants.

In addition, it is unclear to what extent the observed effects of context could change as a function of factors such as the time spent in the context or the familiarity of the context. For instance, longer, more frequent sessions in the museum could mean that teachers become more familiar with the resources and therefore more confident in designing tasks and talking around them, which could result in children remaining more on-task, potentially reducing the amount of decontextualized talk. Moreover, more frequent sessions in the museum could mean that the children are desensitised to the novelty of the environment, thus, teachers may spend less time managing behaviours that arise from distraction. Similarly, more frequent sessions in the classroom with different sets of museum resources could promote different kinds of talk from teachers once they were comfortable and confident using the resources. Overall, however, although data were only taken from a small set of teachers in the present study, findings are suggestive of the wider relations between learning context and

linguistic input.

Since no existing research to our knowledge compares how environmental context affects linguistic input from teachers while controlling for the teaching activity, and no studies contrast museums specifically as a learning context with other educational settings, our findings, while exploratory and observational, make interesting and important novel contributions to the field. The present study is the first to provide empirical support for claims that museums could support children's language development by promoting higher quality linguistic input from teachers in terms of greater levels of decontextualised talk compared to in the classroom. Additionally, the present study demonstrates that teachers used a higher proportion of rare words when teaching in the classroom with museum resources compared to teaching in the museum or teaching in the classroom with regular classroom resources. These findings suggest that teaching in such environments may enrich children's language learning. Offering complex linguistic input in the form of decontextualised talk and the use of rare words can enhance vocabulary and abstract thinking, thus, providing children with opportunities to develop their language skills.

More broadly, the findings underpin the value of collaborative relationships between schools and museums by demonstrating the possible advantages of both class visits to museum contexts, but also of museums loaning resources to school settings. By integrating museum resources into classroom teaching and fostering immersive learning experiences in museums, educators can create richer, more varied language learning environments that benefit children's cognitive and linguistic development.

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Data, Code and Materials Availability Statement

The data supporting the findings reported in this paper are openly available from the Open Science Framework repository at: https://osf.io/zj4fe/?view_only=0bb630aed1674842b1d0b7c63d2ef798

Ethics Statement

This study was approved by the Psychology, Communication and Human Neuroscience Division Panel at the University of Manchester. Ref: 2019-8263-12545

Authorship and Contributorship Statement

All listed authors meet the *Language Development Research* journal criteria for authorship. Specifically, each author has made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; participated in drafting the manuscript or revising it critically for important intellectual

content; provided final approval of the version to be published; agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Individual author contributions are as follows. **Nicola Lester:** Conception and design of the study; data acquisition and interpretation; data analysis; manuscript drafting. **Katherine E. Twomey**: Conception and design of the study; statistical analysis; critical revision of the manuscript; final approval of the manuscript. **Anna Theakston**: conception and design of the study; critical revision of the manuscript; final approval of the manuscript.

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