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Social disparities in the vocabulary of 2-year-old children and the mediating effect of language-stimulating interaction behavior

Abstract

It is well documented that children's language skills already vary by socioeconomic status by the time they are about 2-3 years old. In addition, study results demonstrate that the frequency of language-stimulating interaction behavior – as an important aspect of the proximal familial learning environment – significantly predicts children's later language skills. However, it is less clear how early social disparities in children's language emerge and to what extent they are mediated by maternal language-stimulating interaction behavior. Therefore, we investigated disparities in children's vocabulary at 26 months of age and analyzed whether and to what extent the effect of maternal education on vocabulary acquisition is mediated through language-related episodes of joint attention, as a facet of language-stimulating interaction behavior. We used data from N = 778 children of the Infant Cohort Study of the German National Educational Panel Study.

The results show early disparities in children's vocabulary development as well as in language stimulating interaction behavior in mother-child interaction according to maternal education; however, only 9 % of the effect of maternal education on early vocabulary development is mediated through the assessed language stimulating interaction behavior when controlling for child language skills at 14-17 months of age.

Keywords

Early childhood; Social disparities; ELFRA; Joint attention; Vocabulary

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Soziale Disparitäten im kindlichen Wortschatz von zweijährigen Kindern und ihre Vermittlung durch sprachanregendes Interaktionsverhalten

Zusammenfassung

Es ist breit dokumentiert, dass Sprachkompetenzen von Kindern bereits im Alter von etwa 3 Jahren in Abhängigkeit vom sozioökonomischen Hintergrund variieren. Gleichzeitig zeigen Befunde, dass die Häufigkeit des sprachanregenden Interaktionsverhaltens als Aspekt der proximalen familiären Lernumgebung bedeutsam mit dem Spracherwerb der Kinder zusammenhängt. Weniger klar ist jedoch, wie entsprechende Unterschiede in den frühen sprachlichen Fähigkeiten und Fertigkeiten von Kindern entstehen und ob bzw. inwieweit sie durch mütterliches sprachanregendes Interaktionsverhalten vermittelt werden. Daher untersuchen wir Unterschiede im kindlichen Wortschatz im Alter von 26 Monaten und analysieren, inwieweit Effekte der mütterlichen Bildung auf den Wortschatz ihrer Kinder durch sprachrelevante Episoden geteilter Aufmerksamkeit (joint attention), als eine Facette sprachfördernden Interaktionsverhaltens, vermittelt werden. Hierzu wurden Daten von N = 778 Kindern der Säuglingskohorte des Nationalen Bildungspanels genutzt.

Die Ergebnisse unserer Analysen zeigen sowohl frühe Unterschiede im kindlichen Wortschatzerwerb als auch im sprachstimulierenden Interaktionsverhalten im Zusammenhang mit der mütterlichen Bildung; dabei werden aber nur 9 % der Effekte der mütterlichen Bildung auf den kindlichen Wortschatzerwerb durch das erfasste sprachstimulierende Interaktionsverhalten vermittelt, wenn der kindliche Sprachstand im Alter von 14 resp. 17 Monaten kontrolliert wird.

Schlagworte

Frühe Kindheit; Soziale Disparitäten; ELFRA; Geteilte Aufmerksamkeit; Wortschatz

1. Introduction

Indisputably, the early years of a child's life are important for their later educational development (Belsky et al., 2007). Following the results of previous research, language development plays a key role for later development as well as for school readiness, reading skills, and school success (NICHD Early Child Care Research Network, 2005; Rowe, Raudenbush, & Goldin-Meadow, 2012; Bates, Dale, & Thal, 1996; Weinert & Ebert, 2017). It has even been suggested that language skills in early childhood are the best predictor of school readiness and later school success (Hoff, 2013). Having said this, it seems even more challenging that children's expressive and receptive language varies by socioeconomic background so early in life (Hart & Risley, 1995; Linberg & Wenz, 2017; Fernald, Marchman, & Weisleder,

2013; Hoff, 2006; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010). Already at the age of 2 years, children's productive vocabulary was found to be associated with the socioeconomic status (SES) of the family (Attig & Weinert, 2019; Fernald et al., 2013). Moreover, these disparities seem to be rather stable across preschool age (Weinert & Ebert, 2013).

In various developmental and educational models, such as the bio-ecological model (Bronfenbrenner & Morris, 2006) or the model of educational quality (Roßbach, 2005), these SES-related disparities are explained by differences in educational processes within learning environments associated with the different socioeconomic and educational characteristics of the family. In particular, these models suggest that socioeconomic and cultural resources may influence the prospects of providing stimulating educational processes for the child, which in turn impacts the development of child competencies. In these models, educational processes are seen as a primary engine of competence development, which serve as a mediator between socioeconomic characteristics and child outcomes (Bronfenbrenner & Morris, 2006; Roßbach, 2005). During the first years of life, it is suggested that the interactions between parent and child are particularly important for educational processes within these learning environments (Bornstein, 2002). In line with that assumption, research has shown that, for example, the global quality of interaction behavior (e.g. sensitivity) as well as joint activities are associated with language development in childhood (Olson, Bayles, & Bates, 1986; Tamis-LeMonda, Bornstein, Baumwell, & Damast, 1996; Tamis-LeMonda, Bornstein, Kahana-Kalman, Baumwell, & Cyphers, 1998). Further, these educational processes vary according to the socioeconomic and educational characteristics of the family (Gudmundson, 2012; Weinert & Ebert, 2017).

Although the interrelation between social disparities, language development, and the role of the quality of interaction behavior is well documented, the mediation, which is assumed in developmental and educational models, has rarely been tested explicitly (Tudge, Mokrova, Hatfield, & Karnik, 2009). Thus, it is still an open question to what extent early social disparities in the language development of children (i.e. disparities in child language that are associated with differences in socioeconomic family background) are mediated by the quality of interaction behavior. However, and despite some general interrelations, from a theoretical as well as from a practical point of view, it is important to specify the general concept of quality of interaction behavior. In fact, which facet of interaction behavior promotes language acquisition may differ according to the phase of language acquisition as well as the respective language component under study (e.g. Vallotton, Mastergeorge, Foster, Decker, & Ayoub, 2017). Hence, the aim of present paper is to investigate the mediating role of a specific facet of early language-stimulating interaction behavior which is suggested to be especially relevant to vocabulary acquisition in the second year of life (Baldwin, 1995; Farrant & Zubrick, 2012), namely the frequency of language-related joint attention episodes.

2. Social disparities and language development

Differences in socioeconomic background are already shown in the language skills of 3-year-old children (Hart & Risley, 1999; Weinert & Ebert, 2013). Hoff (2013) stated that children from families with low socioeconomic status showed lower levels of oral language skills than children from more advantaged families (see also Fernald et al., 2013; Hoff, 2006; Huttenlocher et al., 2010; Law, Clegg, Rush, Roulstone, & Peters, 2019). Within the language domain, vocabulary in particular is suggested to be related to family background (for a brief overview: Vasilyeva & Waterfall, 2011). Study results by Hart and Risley (1995) point out that children growing up in families with a low SES have smaller vocabularies and more restricted language skills compared to their peers from higher SES families. Already at the age of 18 months, Fernald and colleagues (2013) documented differences in productive vocabulary and language processing related to social background. At 2 years of age children from families differing in SES already showed a 6-month gap in language processing skills important to language development (Fernald et al., 2013). However, the data patterns are somewhat controversial as Peyre et al. (2014) found that parental education predicts the language skills of their children at the age of 3 years but not the child's vocabulary at 2 years of age.

Yet, as Bornstein and Bradley (2010), amongst others, pointed out, socioeconomic background is a multi-dimensional construct and, for instance, occupation, income and education may have differential influences. Especially in the first years of a child's life, as mothers often withdraw from the labor market, occupation and income are extremely volatile compared to the rather stable dimension of education (Bornstein, Hahn, Suwalsky, & Haynes, 2010). Study results focusing on the latter dimension demonstrate an association of maternal education and child language. For example, using the data of the infant cohort study of the German National Educational Panel Study (NEPS), Attig and Weinert (2019) showed that maternal education already predicted the language level (a combination of productive vocabulary and grammar) at the age of two. Further, Law, Rush, Anandan, Cox, and Wood (2012) also found that maternal education predicted the productive vocabulary of 5 year olds as well as the change in vocabulary skills from 3-5 years.

3. Language-stimulating behavior in mother-child interaction and language development

Sylva, Melhuish, Sammons, Siraj-Blatchford, and Taggart (2008) claimed that, in terms of child development, what parents are doing with their children in their daily life is more important than their socioeconomic background. In line with this assumption, studies suggest that social disparities in children's language development (i.e. disparities in language related to social background) mainly reflect differences in experiences and educational processes, not just individual differences in

basic abilities or capacities – at least in typically developing children (Dale et al., 1998; Hoff, 2003; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002).

Studies focusing on the global quality of educational processes demonstrate that the quality of interaction behavior is associated with the language skills of children (Baumwell, Tamis-LeMonda, & Bornstein, 1997; Nozadi et al., 2013; Pungello, Iruka, Dotterer, Mills-Koonce, & Reznik, 2009). In addition, there is evidence that sensitive parenting behavior as indicated by a prompt, contingent, adequate and warm reaction to the child's needs and signals predicts language outcome (Tamis-LeMonda, Briggs, McClowry, & Snow, 2009; Tamis-LeMonda et al., 1996; Tamis-LeMonda et al., 1998). More specifically, it was shown that children of more sensitive mothers begin to talk earlier and reach the milestone of a 50-word productive vocabulary at a comparatively younger age than children of less responsive mothers (Tamis-LeMonda et al., 1996; Tamis-LeMonda et al., 1998). Attig and Weinert (2019) added that mothers' sensitive and stimulating behavior as well as the frequency of early joint picture book reading predicted language skills in 2 year olds with all three predictors explaining separated amounts of variance.

However, via an animated discussion it is suggested that indicators aiming to measure the global quality of educational processes might underestimate the associations with specific domains, such as language (Anders et al., 2012; Lehl, Ebert, Blaurock, Roßbach, & Weinert, 2019; Mashburn et al., 2008). In addition, within global measures of interaction quality various specific behaviors that may or may not be relevant are included. Therefore, it seems important to focus on more specific processes that are suggested to stimulate the development of specific domains such as language. Yet, as already mentioned, which facet of interaction behavior is most relevant might depend on the phase of language development and the language component under study (e.g. Weinert & Grimm, 2018 for an overview). In fact, with respect to language development from the early years onwards, various interactional variables have been shown to impact developmental progress, ranging from stimulating verbal interactions including questioning and verbal distancing as well as language teaching strategies such as repeating, expanding, and reformulating the child's utterances (Hoff-Ginsberg & Shatz, 1982) and the quantity and quality of picture book exposure to specific features of speech input such as the complexity of adult talk to children (Anderka, 2018; Huttenlocher et al., 2002) or the diversity of word used (Weinert & Lockl, 2008 for an overview) with partially differentiated effects on child vocabulary (Lehl, Ebert, Roßbach, & Weinert, 2012; Vasilyeva & Waterfall, 2011). With respect to the second year of life, it is suggested that language-related joint attention episodes, amongst others, may be particularly relevant to a child's language development and early word learning (e.g. Baldwin, 1995; Tomasello & Farrar, 1986; Bruner, 1978), as within those episodes children are more easily able to associate words with specific objects or scenes and thus to unravel the meaning of new words. In line with this assumption, study results show that vocabulary growth is predicted by the time mother-child dyads spend in joint attention (Carpenter, Nagell, & Tomasello, 1998; Laakso, Poikkeus, Katajamaki, & Lyytinen, 1999) as well as by maternal input that follows the child's

attentional focus (Akhtar, Dunham, & Dunham, 1991; Tomasello & Farrar, 1986). Further, language skills develop more rapidly if children are advanced in achieving joint attentional states (Carpenter et al., 1998; Mundy & Gomes, 1998).

4. Social disparities and language-stimulating interaction behavior

In bio-ecological and educational quality models the home learning environment is seen as a multidimensional construct. According to the models, the SES of the family influence educational processes which in turn impacts the development of the child. Hence, the models suspect a mediation of the effect of SES on child outcome via educational processes (Bronfenbrenner & Morris, 2006; Roßbach, 2005). Following this idea, the above mentioned SES-related disparities in language acquisition might be due to related differences in interaction quality. Research not only shows differences in child development according to SES but also with respect to the interaction quality and the language use of parents (Hoff, Laursen, & Tardif, 2002). Thus, associated with the socioeconomic status of the family and particularly the level of education of the mother, various differences have been documented in the literature. For instance, the global quality of the home learning environment (HLE; as, for example, measured by the Home Observation for Measurement of the Environment Inventory; Bradley & Caldwell, 1979) has been shown to be associated with the education level of the family (Bradley, Corwyn, McAdoo, & Coll, 2001; Lugo-Gil & Tamis-LeMonda, 2008; Magnuson, Sexton, Davis-Kean, & Huston, 2009). Further, compared to mothers with lower education, higher educated mothers showed a higher global quality of interaction behavior (Bradley et al., 2001; Gudmundson, 2012; Attig & Weinert, 2018). In addition, language-stimulating interaction behavior has been shown to differ according to the families' education level (Hoff, 2003). In particular, the amount of talking as well as the qualitative and interactive aspects of mothers' speech differ according to her education level. Higher educated mothers talk more to their children and their language input to their children is suggested to be more supportive for language development compared to less educated mothers (Hart & Risley, 1995; Hoff, 2003, 2013; Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007). Rowe (2012) found that more highly educated parents used more word tokens and word types as well as more rare words and more decontextualized utterances at 18 months, 30 months and 42 months of age. Even more, mothers also differ in the purpose of language use depending on their socioeconomic status (e.g., in directing children's behavior or eliciting and maintaining conversation; Hoff, 2006; Hoff et al., 2002).

However the findings are at least partially controversial. While Hart and Risley (1992, 1995) extrapolated their findings to the famous statement that, at the age of 3 years, children from low SES families hear 30 million words less compared to children from high SES families, others could not replicate this finding (e.g. Sperry,

Sperry, & Miller, 2018; see Golinkoff, Hoff, Rowe, Tamis-LeMonda, & Hirsh-Pasek, 2019; Sperry, Sperry, & Miller, 2019 for a critical discussion of the findings). Further, SES-related disparities in grammar seem to be mediated by partially different facets of interactive communications in contrast to disparities in vocabulary (Anderka, 2018).

With respect to SES indicators, as already mentioned, it is claimed that maternal education is especially relevant for stimulating interactions with very young children (Duncan & Magnuson, 2010) as, amongst others, mothers with higher education are found to gather more information on parenting and child development, which might impact their interaction behavior (Bornstein, Cote, Haynes, Hahn, & Park, 2010; Fagan, 2017).

5. Present study

To sum up, language-stimulating processes have been shown to impact vocabulary development, which unfold on the background of the socioeconomic resources of the family. In addition, during the first years of a child's life, maternal education seems to be a key dimension of socioeconomic background.

In bio-ecological theories (Bronfenbrenner & Morris, 2006) or theories of educational quality (Roßbach, 2005) it is often assumed that structural characteristics, such as socioeconomic resources, exert an influence on child development through educational processes. Although empirical results show that maternal education is associated with the language status of 2-year-old children (Attig & Weinert, 2019), the mediation is rarely tested (Tudge et al., 2009). In addition, this paper takes a domain-specific developmental approach, assuming that specific facets of stimulation might be particularly relevant to domain-specific developmental tasks.

Thus, we aim to investigate whether domain-specific language-stimulating interaction behavior during mother-child interaction and particularly the frequency of language-related joint attention episodes (assessed by a combined time- and event-sampling coding approach), might mediate the effect of maternal education on the development of early productive vocabulary.

Research Questions:

- 1) To what extent is the early development of vocabulary (namely productive vocabulary at age 2 when controlling for earlier language skills) related to maternal education?
- 2) To what extent is the frequency of language-related joint attention episodes as language-stimulating interaction behavior related to maternal education in the second year of life (when controlling for the child's language status which might affect mothers' behavior)?
- 3) Does the assessed early language-stimulating interaction behavior mediate the effect of maternal education on vocabulary development in 2 year old children?

6. Methods and data

6.1 Sample

We used data of the Starting Cohort 1 – Newborns of the NEPS (NEPS; Blossfeld & Roßbach, 2019; Weinert, Linberg, Attig, Freund, & Linberg, 2016) of the first three waves to address these research questions. In wave 1 children were 7 months old; in wave 2 parent interviews took place when children were 14 months and the assessment of interaction behavior when they were 17 months old; in wave 3 children were 26 months of age. Starting Cohort 1 is a representatively drawn sample of around 3,500 children born between February and June 2012 and their families, who were followed up longitudinally (Weinert et al., 2016).

In the second wave – by design – only half of the sample was assessed by video-observational measures, including the measure for language-stimulating interaction behavior. In our analyses we used all cases in which valid information on child’s vocabulary at wave 3 (26 months) and valid information on language stimulating interaction behavior in wave 2 (17 months) were available, but excluded cases in which another language than German was exclusively the interaction language in the household, which resulted in a total sample size of 778 children.

6.2 Vocabulary at 26 months

Child’s *vocabulary at 26 months* was assessed by the ELFRA-2, a standardized parental report on child language including a vocabulary check-list of 260 words and phrases the child actively uses (ELFRA; Grimm & Doil, 2006). This instrument is comparable to the internationally well-known and extensively validated “MacArthur-Bates Communicative Development Inventories (Toddler Form) – CDI” (Fenson et al., 1993; for the validity of the ELFRA see Sachse, Anke, & von Suchodoletz, 2007).

6.3 Language-stimulating interaction behavior at 17 months

As an indicator for language stimulating interaction behavior we used information on language-related joint attention episodes at the age of 17 months, which was based on videos of a semi-standardized interaction situation between mother and child playing in the home-setting with a standardized toy set for 10 minutes in German (see Linberg et al., 2019 for detailed information on design and set-up). Mothers were asked to play with the child as she would normally do when having time and being alone with the child. These videos were coded with a combined

time- and event-sampling approach using 15 second intervals (see Linberg, 2018).¹ For each of the 15 second time intervals the raters coded whether the mother was engaging in a joint attention episode [0: no; 1: yes] with the child, indicated by attention of both interaction partners on the same object / event, and whether any language was used by the mother (excluding fillers such as “mh”) [0: no; 1: yes] (Linberg, 2018).

If both aspects were coded with yes, the interval was coded as an interval in which language-related joint attention episodes were demonstrated as an indicator of language-stimulating behavior (interrater-agreement = 77 %). In our analyses, we used the percentage of all possible 40 intervals in which the respective indicator occur.

6.4 Maternal education

As an SES characteristic we considered maternal education at wave 2 (at the age of 14 months) as this is a rather stable SES characteristic (compared to income which, due to maternal leave regulations, is rather volatile in the first years of a child’s life; (Bornstein & Bradley, 2010) and considered to particularly relevant to the research question under study (e.g. Law et al., 2012). We used the CASMIN-classification (König, Lüttinger, & Müller, 1988), an indicator for maternal education, containing information on school and vocational training certificates, ranging from 1-8 with [1] indicating general elementary education, [4] secondary school leaving certificate with vocational training and [8] higher tertiary education (university degree).

6.5 Controls

In order to control for children’s earlier language skills, we included *verbal expressions* of the child as coded based on the videotaped mother-child interaction situation at 17 months of age as well as a rough proxy for the child’s early *productive vocabulary* assessed in the parent interview at 14 months of age when parents were asked how many people or things the child names correctly, ranging from [1] none to [5] more than 20. For child’s *verbal expressions*, raters indicated (off-line coding) whether the child has spoken one- or two-word sentences during a time interval (interrater-agreement = 79%) and we used the percentage of all intervals coded ‘yes’ as an indicator.

We also included two additional SES indicators from wave 2 in our analyses: Weighted *household income* (OECD, 2013) as an indicator of financial resources

1 These codings were conducted within the ViVA-project (Video-based Validity Analyses of Measures of Early Childhood Competencies and Home Learning Environment) funded by the German Research Foundation (DFG; grant to S. Weinert and H.-G. Roßbach) within the priority program 1646.

and the variable *single parent*, which is defined by a partner living in household [0] no [1] yes, as an indicator of social resources, as for both indicators associations to child language as well as to the home learning environment have been demonstrated (e.g. Linberg & Wenz, 2017; Sylva et al., 2008; Huttenlocher et al., 2010).

Furthermore, we controlled for child's *age* at wave 2 and 3, and whether the *child is a boy* [0] no [1] yes and the language spoken in the household assessed in wave 1 (1 = *only German*, 2 = *mostly German*, 3 = *mostly another language*). Descriptives for all variables are shown in Table 1.

Table 1: Descriptives

	<i>N</i>	<i>M</i> / %	<i>SD</i>	Min	Max
Child's Vocabulary ₂₆	778	147.12	62.06	2	260
Child's verbal expressions ₁₇	778	21.71	18.58	0	90
Child's vocabulary ₁₄	770	2.16	0.85	1	5
Maternal education	769	6.17	1.85	0	8
Household income	753	1750.00	796.21	100	6250
Single parent (0 = no 1 = yes)	770	4.55 %		0	1
Language-stimulating interaction behavior	778	67.06	16.38	0	97.5
Child's age ₁₇ (in months)	778	17.03	0.67	16	20
Child's age ₂₆ (in months)	778	26.38	1.14	24	32
Child is a boy (0=no 1=yes)	778	51.93 %		0	1
Household language (1 = German; 2 = sometimes other; 3 = mostly other)	778	1.15	0.42	1	3

6.6 Analytic strategy

For analysing disparities according to maternal education (a) in child's vocabulary at the age of 26 months as well as (b) in the frequency of joint attention episodes as an indicator for the language-stimulating interaction behavior the child experienced at the age of 17 months we used path models (with correlated covariates) and controlled for child's age in the wave of interest, child's gender, household language, household income, and single parent. Moreover, as language-stimulating interaction behavior (in wave 2) might be a reaction to the child's actual language skills, we additionally controlled for children's language skills in the second year of life by including the child's verbal expressions in the interaction situation and vocabulary at wave 2 (see correlations in the appendix between the child's verbal expressions and the language-stimulating interaction behavior at 17 months of age: $r = .24, p < .001$). Note, that by doing so, we more clearly address language development instead of just effects on language status (correlations between variables (see appendix) reveal some stability in individual differences in early language development ($r = .42, p < .001$; $r = .29, p < .001$) in the second year of life). For test-

ing the mediation of the effect of maternal education through language-stimulating interaction behavior, we used path models, in which direct, indirect and total effects for each predictor were estimated and indicated by the estimated Bentler-Raykov R^2 . Missing variables (max. 3 %) were treated using full-information-maximum-likelihood estimation (Acock, 2013) using all valid information of all observations with Stata 15.

7. Results

7.1 Disparities in child’s vocabulary

Regarding SES-related disparities in children’s vocabulary, our bivariate analyses (see Table A1) demonstrate no or only small significant associations between maternal education and our proxies for child language skills and vocabulary at 17 and 14 months respectively. However, significant bivariate associations are observable at 26 months (see Table A1), which are even apparent in path models when controlling for earlier language skills. This association remains significant when other SES characteristics are additionally included in the model (Table 2). In fact, the effect of maternal education stayed rather stable when the model controlled for income and family status (single parent). However, only 2 % of variance in child’s vocabulary development is explained by maternal education.

Table 2: Separate prediction of child’s vocabulary at 26 months by maternal education with control variables

	Vocabulary ₂₆	Vocabulary ₂₆	Vocabulary ₂₆
Maternal education		.14***	.11**
<i>Control variables</i>			
Child’s age ₂₆	.21***	.20***	.20***
Child is a boy	-.11***	-.11***	-.10**
Child’s verbal expressions ₁₇	.33***	.32***	.32***
Child’s vocabulary ₁₄	.20***	.21***	.21***
Household language	-.10**	-.08**	-.07*
Household income			.07*
Single parent			-.03
R^2	.28	.30	.30

Notes. $N = 778$. Standardized coefficients.
[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

7.2 Disparities in language-stimulating interaction behavior

In the next step, SES-related disparities in the frequency of language-related joint attention episodes as a dimension of language-stimulating interaction behavior during the semi-standardized play situation at 17 months of age was analyzed. Again, the observed disparities in language-stimulating interaction behavior according to maternal education are significant in bivariate analyses ($r = .16$, $p < .001$; see Table A1) and also remain significant when controlling for concurrent child language and other child and SES characteristics (Table 3).

Table 3: Separate predictions of language-stimulating interaction behavior at the age of 17 months with control variables

	Language-stimulating interaction behavior ₁₇	Language-stimulating interaction behavior ₁₇	Language-stimulating interaction behavior ₁₇
Maternal education		.13***	.12***
<i>Control variables</i>			
Child's age ₁₇ (in months)	.06	.04	.05
Child is a boy	-.12**	-.11**	-.11**
Child's verbal expressions ₁₇	.22***	.21***	.21***
Child's vocabulary ₁₄	-.01	-.01	-.01
Household language	-.09*	-.07*	-.07*
Household income			.03
Single parent			-.01
R^2	.08	.10	.10

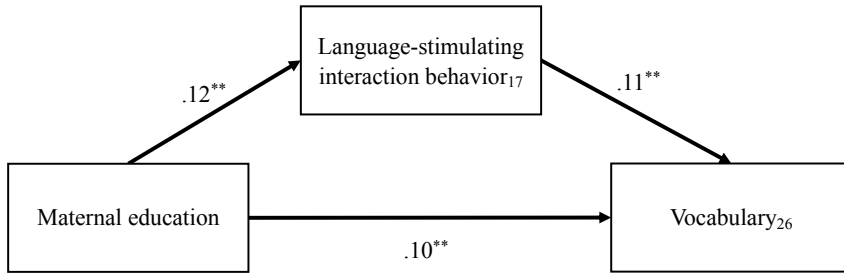
Notes. $N = 778$. Standardized coefficients.

+ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

7.3 Mediation

In a last step we tested to what extent the effect of maternal education on child's vocabulary at wave 3 was mediated by language-stimulating interaction behavior. Using a path model, we estimated the effect of maternal education on the frequency of language-stimulating interaction behavior and child's vocabulary, as well as the effect of language-stimulating interaction behavior on child's vocabulary at wave 3 simultaneously, while controlling for child's earlier language skills and further child and SES characteristics (see Table 4). Of the total effect ($\beta = 0.11$) only ($\beta = 0.01$) is indirect, meaning 9 % of the effect of maternal education is mediated through language-related joint attention episodes (Table 5).

Figure 1: Simplified model of the relation of maternal education, language-stimulating interaction behavior at the age of 17 months and vocabulary at the age of 26 months



Notes. $N = 778$. Standardized coefficients. $R^2_{\text{Language-stimulating interaction behavior}_{17}} = .10$; $R^2_{\text{Vocabulary}_{26}} = .31$; controlled for child's verbal expression₁₇, vocabulary₁₇, age₂₆; gender, as well as for household language and household income.

⁺ $p < .10$. ^{*} $p < .05$. ^{**} $p < .01$. ^{***} $p < .001$.

Table 4: Relation of maternal education, language-stimulating interaction behavior at the age of 17 months and vocabulary at the age of 26 months

	Language-stimulating interaction behavior ₁₇	Vocabulary ₂₆
Maternal education	.12**	.10**
Language-stimulating interaction behavior ₁₇		.11**
<i>Control variables</i>		
Child's age ₁₇	.05	
Child's age ₂₆		.19***
Child is a boy	-.11**	-.09**
Child's verbal expressions ₁₇	.21***	.30***
Child's vocabulary ₁₄	-.01	.21***
Household language	-.07*	-.07*
Household income	.03	.07*
Single parent	-.01	-.03
R^2	.10	.31

Notes. $N = 778$. Standardized coefficients.

⁺ $p < .10$. ^{*} $p < .05$. ^{**} $p < .01$. ^{***} $p < .001$.

Table 5: Standardized effects of maternal education and language stimulating interaction behavior at the age of 17 months with direct and indirect effects

Outcome	Direct effect	Indirect effect	Total effect
Maternal education → Language-stimulating interaction behavior ₁₇	.12**	-	.12**
Maternal education → Vocabulary ₂₆	.10**	.01*	.11**
Language-stimulating interaction behavior ₁₇ → Vocabulary ₂₆	.11**	-	.11**

Notes. $N = 778$. Standardized coefficients.

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .001$.

8. Discussion

Language competencies already differ early in a child's life by socioeconomic background (e.g. Hart & Risley, 1995; Huttenlocher et al., 2010). This is rather concerning as early language skills predict later language competencies and are important for academic success and participation in society (e.g. NICHD Early Child Care Research Network, 2005; Rowe et al., 2012; Weinert & Ebert, 2017). Different theories point to the important role of educational processes, e.g. in interactions between the mothers and their children, for the "transmission" of these disparities and the emergence of SES-related differences in child development (Bronfenbrenner & Morris, 2006; Roßbach, 2005). However, it is still rather unclear to what extent domain-specific educational processes, such as language stimulating interaction behavior, serve as a mediator of the effects of socioeconomic status in early childhood.

The present paper therefore addressed three main questions: (1) whether disparities in vocabulary development at the age of 26 months by maternal education are still observable when controlling for earlier language skills and other child and SES characteristics; (2) whether SES related disparities in the frequency of episodes of joint attention as a facet of language-stimulating interaction behavior in mother-child interactions are visible even when controlling for early child language and other characteristics and (3) whether the disparities in child's vocabulary can be explained by differences in the respective language-stimulating interaction behavior, namely whether the effect of maternal education on a child's vocabulary development is mediated by the frequency of language-related joint attention episodes taking a proxy for earlier language skills into account. While the first question addresses the specificity of the association between maternal education and vocabulary development between 17 and 26 months, the second focusses on the relation between maternal education and a potentially functional interaction variable that is suggested to be particularly relevant to vocabulary acquisition in the second year of life. Both questions are the basis for the mediation model which analyzed whether these educational processes mediate the effect of maternal education on

vocabulary development in the second half of the second year of life when productive vocabulary increases substantially.

Our results demonstrate that – already at the age of 26 months – the children’s productive vocabulary is significantly associated with maternal education. This association has also been reported by Attig and Weinert (2019) and is in line with previous study results that found a relationship between children’s productive vocabulary and their socioeconomic family background already at two years of age (Fernald et al., 2013). The present study adds to these previous results that the association still holds true if proxies for the child’s earlier vocabulary and language skills are taken into account. This result hints to the relevance of maternal education for early vocabulary development. In addition, compared to other characteristics of socioeconomic background, maternal education shows the strongest association with child’s vocabulary development; however, the association is only mediocre in nature. Yet, studies focusing on older children point to an increase of SES-related disparities over time (Lehrl et al., 2012; Linberg & Wenz, 2017). For instance, Weinert and Ebert (2013) showed that the social background accounted for 6-12 % of the differences in the language skills of 3-year-old children. Overall, the data pattern of the present study hints to an early emergence of SES-related disparities in children’s vocabulary during the second year of life, as – on a bivariate level – facets of SES were even less associated with the assessed proxies of early child language and vocabulary at 17 and 14 months respectively.

With respect to the second main question, our data shows a significant association between maternal education and the frequency of mothers’ engagement in language-stimulating behavior in an interaction situation. A higher number of language-related joint attention episodes was found in families with higher educated mothers compared to lower educated mothers. Yet, by showing this association between maternal education and language relevant episodes of joint attention, our study results contribute to and expand existing findings on the association between SES (particularly maternal education) and various measures of general as well as domain-specific quality of educational processes. Thus, for instance, study findings by Hart and Risley (1995) also point to the assumption that children in low SES families experience significantly less language stimulation (herein the number and diversity of words) compared to children from higher SES families. But, as already mentioned, a recent study by Sperry and colleagues (2018) could not replicate this finding (Hart & Risley, 1992, 1995). Besides showing hardly any SES-related disparities in the number of words children heard, they documented a great variation in the language learning environments within the different socioeconomic stratum. Further, their results suggest that not only direct speech from the primary caregiver plays a role, but also the language input from other caregivers as well as bystander talk (see Golinkoff et al., 2019; Sperry et al., 2019 for a critical discussion of the findings). The association of maternal education and language stimulating behavior might be traced back to differences in gathering information on supportive interaction behavior (Bornstein et al., 2010; Fagan, 2017) which may impact the behavior in interaction situations. However, further studies are needed to ad-

dress this possible link explicitly. Likewise, higher education may lead to cognitive and socio-cognitive resources and competences that may allow on the one hand, to perceive and correctly interpret the child's signals comparatively better, which might be important in establishing joint attention episodes (Carpenter et al., 1998); on the other hand, these resources or competencies may help to learn more efficiently from everyday interactions with the child, to adapt to the child's needs and signals and to derive stimulating behaviors from them. Of course, we cannot rule out the possibility that personal or other factors that we did not control for may have contributed to the observed interrelation.

Further, our results support the assumption that the frequency of joint attention episodes may be relevant to vocabulary acquisition. First, we find a predictive association between the frequency of these episodes and later vocabulary; second, this association was still observable when controlling for the child's earlier language skills suggesting an effect on vocabulary development and thus a relationship that goes beyond a pure predictive association with later vocabulary status. Note that joint attention episodes may also be initiated by the child (Baldwin, 1995); in addition, the mother may react to characteristics of the child. Thus, it is particularly relevant that the associations with later child language remained significant even when controlling for various child characteristics including a proxy of early language status. Yet, controlling for early child language may at the same time lead to a rather conservative estimation of the effect of mothers' language stimulating behavior. If this behavior is rather stable across the second year of life and impacts child language already at 17 months of age, controlling for early child language leads to an underestimation of the effect which may be more pronounced from a developmental point of view that highlights cumulative effects.

Focusing on the assumed mediation of disparities, our study showed that only a very small proportion of the disparities in the children's vocabulary could be traced back to differences in the assessed indicator of language stimulating experiences. In fact, only 9 % of the effect of maternal education is mediated through the frequency of language-related episodes of joint attention. There are many aspects that could possibly account for this finding which we, however, cannot directly address and disentangle in our study. First, we measured only one specific facet of language stimulating behavior and second, we did so by drawing on a ten-minute interaction situation which may reduce differences. Third, mother's education may be associated with many factors over and above the specific interactional measure we used as well as beyond direct mother-child interactions. In fact, various variables have been shown to contribute to early child language development such as the quantity and diversity of words (Hart & Risley, 1995), but also quality as indicated by use of shared symbols and conversational fluency; (Hirsh-Pasek et al., 2015), maternal guiding language (Dave, Mastergeorge, & Olswang, 2018) as well as verbal stimulation and responsiveness (Olson et al., 1986). Thus, many aspects of language stimulation behavior seem to play a role for the developing language skills of the children and may also mediate the effect of maternal education on these skills.

Further, SES and maternal education are associated with decisions on early extrafamilial childcare, which has also been shown to be associated with children's language development (e.g., NICHD Early Child Care Research Network, 2005). Although we did not find an association of childcare attendance and child's language skills at this age in our data, we could not exclude the possible impact of the actual (language fostering) experiences within childcare on child language. Investigating the impact of the different learning environments and their possible interactions with a special focus on domain-specific processes could be part of further studies. In addition, other limitations must be mentioned.

First of all the videotaped interaction only lasted 10 minutes and therefore represents only a short insight into everyday language stimulating behavior. However, ecologic validity of the observed maternal interaction behavior seems to be high, as results from a validation study demonstrate that the interaction behavior assessed in the semi-structured play situation is comparable to interaction behavior in other situations such as natural feeding or diapering (Weinert et al., 2016; Vogel, 2020). Additionally, the measure of maternal language stimulating interaction behavior when children were 17 months old focusses on any language provided in a joint attention episode, which complies with results that show maternal input that follows the child's attentional focus to be especially relevant for language development (e.g., Akhtar et al., 1991; Tomasello & Farrar, 1986). However, we could not differentiate the exact quality of language stimulation (e.g., how or if the mother scaffolds the child's language as described by Bruner (1983) within the concept of a Language Acquisition Support System). Our coding system did not differentiate specific language structures or interactional features which have been shown to be relevant at least for children at the age of two to three years or beyond. This should be addressed in further research. It is also necessary to draw attention to the measurement of child's vocabulary, which has been obtained through parental report (extensive check-list). Obviously, report measures can potentially be influenced by differences in monitoring the child and the child's progress or even by a social desirability response bias. However, the vocabulary list is an established instrument, which shows high external validity, demonstrated by high correlations with established standardized language tests (Sachse et al., 2007). Similar vocabulary lists are used in many studies (Law et al., 2019; Morgan, Farkas, Hillemeiner, Hammer, & Maczuga, 2015; Nozadi et al., 2013) due to the difficulty in testing these young children by standardized measures in large-scale assessments. Specifically, at the age of two, children are already very active and at the same time still restricted in following verbal instructions. As a last point, the sample size should be mentioned, as only a part of the sample could be included in our analyses. Although most of the dropout of the sample is due to design, a bias in the sample could not be excluded.

The present study points out that, even in a well-educated country such as Germany, at the age of 26 months disparities in vocabulary development by maternal education are already visible and that – associated with maternal education – children experience different frequencies of language-related joint attention episodes as a facet of language stimulating interaction behavior of their mothers.

Although, this facet of language stimulating interaction behavior contributes to the child's vocabulary development, these SES-related disparities in a child's vocabulary can hardly be traced back only to differences in those experiences. Overall, our results underline the importance of reducing early disparities in a child's vocabulary from early on, potentially by intensifying parental education programs in order to strengthen the early HLE a child experiences.

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Appendix

Table A1: Intercorrelations among variables

	1	2	3	4	5	6	7	8	9	10
1 Child's vocabulary ₂₆										
2 Child's verbal expressions ₁₄	.42***									
3 Child's vocabulary ₁₇	.29***	.27***								
4 Maternal education	.18***	.06 ⁺	-.05							
5 Household income	.15***	.03	.02	.32***						
6 Single parent (0=no 1=yes)	-.10**	-.08*	-.01	-.08*	-.19***					
7 Language-stimulating interaction behavior ₁₇	.24***	.24***	.05	.16***	.09*	-.05				
8 Child's age ₁₇ (in months)	.01	.19***	.03	.10**	.03	-.02	.10**			
9 Child's age ₂₆ (in months)	.23***	.04	.01	.09*	.09*	-.05	.02	.16***		
10 Child is a boy (0=no 1=yes)	-.17***	-.14***	-.07 ⁺	-.04	-.03	.04	-.15***	-.04	-.02	
11 Household language (1=German; 2=some- times other; 3=mostly other)	-.10**	-.05	.03	-.12**	-.11**	.03	-.10**	-.04	-.01	-.02

Note. $N = 778$.

⁺ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.