English Negative Constructions and Communicative Functions in Early Child Language

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Abstract

How does abstract linguistic negation develop in early child language? Previous research has suggested that abstract negation develops in stages and from more concrete communicative functions such as rejection, prohibition, or non-existence. The evidence for the emergence of these functions in stages is mixed, however, leaving the possibility that negation is an abstract concept from the beginning that can serve multiple specific functions depending on early communicative environment. Leveraging automatic annotations of large-scale child speech corpora in English, we examine the production trajectores of seven negative constructions that tend to convey communicative functions previously discussed in the literature. The results demonstrate the emergence and gradual increase of these constructions in child speech within the age range of 18-36 months. Production mostly remains stable, regular, and close to parents' levels after this age range. These findings are consistent with two hypotheses: first, that negation starts as an abstract concept that can serve multiple functions from the beginning; and second, that negation develops in stages from specific communicative functions but this development is early and quick, leaving our corpus methods incapable of detecting them from the available corpus data.

Keywords: negation; syntactic construction; communicative function; development; child language.

Word count: X

English Negative Constructions and Communicative Functions in Early Child Language

Introduction

Negation is an abstract concept that serves different communicative functions in everyday communication. A coffee shop can divide its menu into "coffee" and "not coffee" sections, with "not coffee" bringing together diverse items with no common label like tea and hot chocolate. It could be used in a sign like "no mask, no entry" to regulate people's behaviors. An employee could say "I don't like Mondays" to communicate their desires or dislikes. But how does abstract multi-functional negation emerge and develop in the human mind? Are early stages of negation in child language specific to one or a few functions? Or does negation emerge as an abstract and multifunctional concept from the beginning?

Previous literature has proposed that abstract negation develops from less abstract communicative functions in ordered stages (Pea, 1978). For instance, Darwin (1872) hypothesized that the earliest manifestation of negation in infants is when they refuse or reject food from parents by withdrawing their heads laterally. Similarly, Pea (1978) also proposed "rejection" as the first function of negation in child language. By contrast, Bloom (1970) argued that the use of negation to express "non-existence" emerges before "rejection." For example, when an object that children expect to be present is not, children may say: "there is no window." Follow-up study by Choi (1988) argued that "prohibition" emerges as early as rejections and non-existence. In cases of prohibition, children use negation to stop others or themselves from performing actions (e.g. "don't go"). A function similar to prohibition is "inability" (e.g. "I cannot zip it"), in that both involve conceptualizing actions and negating them. Choi (1988) suggested that expressions of inability emerge after the functions in the first phase, namely non-existence, rejection, and prohibition.

Despite considerable research on early communicative functions of negation, their developmental trajectories in children's production have remained unclear. Recently,

Nordmeyer and Frank (2018) looked at the speech of five children in the Providence corpus (Demuth, Culbertson, & Alter, 2006) and found a great deal of individual variation in how early a negative function is attested. They reported that the developmental trajectory of negation in their study was not as consistent as previously claimed. This leaves the possibility that negation develops as an abstract concept that can serve multiple communicative functions early in the development based on the context of use in parent-child interactions. Therefore, across (a larger number of) children, distinct functions of negation could develop within the same age range and share common production trajectories.

However, previous experiments have mainly relied on manual annotations of corpus data to determine the communicative function of a given negative utterance, which in turn has limited their work to only a handful of children per study. Here we aim to go beyond existing work via utilizing a large collection of child speech corpora in English (MacWhinney, 2000) along with computational tools to automatically identify negative utterances that tend to convey the communicative functions discussed in prior research (Table 1). In particular, our study investigates three questions: (1) how does the developmental trajectory of the negative constructions for each function look like? (2) for utterances expressing the same function, does the developmental trajectory differ depending on particular lexical items that negation modifies (e.g. *like* or *want* for rejection)? (3) taking all functions into account, do they share similar developmental characteristics, or would there be function-specific differences?

Given the automatic fashion of our approach, we focus on larger/longer negative constructions at the single-sentence level. This is in opposition to short negative forms at the discourse-level such as cases consisting of one morpheme (e.g. “no!”) or repetition of negative morphemes (e.g. “no no no”), which arguably could express multiple functions when not taking the discourse context into account and accordingly leave more room for ambiguous interpretation. Therefore the negative utterances in our study do not fully cover all negation

instances from the corpora investigated, nor reflect all possible communicative functions that could be played by negation more broadly, but it could provide at least a conservative estimate of the age range during which negation is developed gradually in child production.

Related Work

Starting a century and a half ago, Darwin (1872) thought that negation has roots in the expression of human emotions and desires. He hypothesized the earliest manifestation of negation and affirmation in infants is when they refuse food from parents, by withdrawing their heads laterally, or when they accept the food, by inclining their heads forward. He suggested that head shaking and nodding as common gestures for negation and affirmation pro developed from this early habit. Similarly, many researchers studying early functions of negative morphemes like *no* proposed that children use them to "reject" or "refuse" (Bloom, 1970; Choi, 1988; Pea, 1978). For example, when they are asked "do you want juice?" they may say "no," "not want it," or "don't like it." Pea (1978) proposed this negation function is the first to emerge in children's early speech.

Bloom (1970) argued that the use of negation to expresses "non-existence" emerges before rejection or refusal. For example, when an object that children expect to be present is not present, children may say: "no window," "no fish in the bathroom," or "I do not pro underpants." Two close concepts to non-existence are "disappearance" and "non-occurrence" (Pea, 1978; Villiers & Villiers, 1979). Disappearance refers to situations where an object disappears and children use negation to express it (e.g. "no food. all gone" or "no more noise"). Non-occurrence refers to cases when an expected action or event does not occur as in "not working" or "doggie not barking." Some researchers referred to these cases as "failures" and included examples like "no fit in da box" or "it don't fit" (Cameron-Faulkner, Lieven, & Theakston, 2007; Choi, 1988). Non-existence can also be expressed by negation of locative prepositional phrases (e.g. "no in there" or "daddy was not on the phone"). While

rejection was hypothesized to interact with human emotions and desires, non-existence (broadly construed to include "disappearance" and "non-occurrence") likely interacts with human perception. Choi (1988) proposed that children's early linguistic negation is used to express both rejection and non-existence.

Additionally, Choi (1988) introduced "prohibition" and suggested that it emerges as early as rejection and non-existence. In cases of prohibition, children use negation to stop others from performing actions; for example "don't go" or "do not spill milk." A special case of prohibition is "self-prohibition." For example, a child may approach prohibited food but immediately say "no, don't eat" to stop themselves. A function similar to prohibition is "inability" (e.g. *I can't reach / I cannot zip it*), in that both involve conceptualizing actions and negating them, possibly interacting with early development of motor control. Choi (1988) suggested that expression of inability emerges after the first phase, namely non-existence, rejection, and prohibition.

"Denial" is another function of negation that is argued to be late in development. Bloom (1970) defined it as asserting that "an actual or supposed predication was not the case," for example "It's not sharp." Later researchers formulated it as "truth-functional negation" because it is used to negate the truth of a proposition (Cameron-Faulkner, Lieven, & Theakston, 2007; Pea, 1978). However, this definition depends on the assumed logical system and its assumptions on what type of propositions receive truth values. A particular sub-function of denial is "labeling," which is realized as the negation of nominal or adjectival predicates such as "this is not a bunny" or "not red." These utterances are often used to introduce new linguistic labels by parents and in turn may facilitate word learning (Clark, 2010). Conversely, labeling and word learning may aid the development of abstract negation.

Despite considerable research on early functions of negation, their developmental trajectories in children's productions pro remained unclear. Different studies pro claimed different order of acquisition (Pea, 1978). In a recent study, Nordmeyer and Frank (2018)

looked at the speech of five children in the Providence corpus (Demuth, Culbertson, & Alter, 2006) and found a great deal of individual differences in how early a negative function is attested. This is partly because previous studies pro had to rely on human annotation and identification of functions from corpus data, a time-consuming and difficult process that has limited previous studies to a handful of children and a relatively small sample of their speech.

Experiments

Data and preprocessing

For developmental production data of child speech in English, we turned to the CHILDES database (MacWhinney, 2000)[1] and focused on children with typical development within the age range of 12 - 72 months. Parents' and children's utterances were extracted via the childes-db (Sanchez et al., 2019) interface using the programming language R. In order to obtain (morpho)syntactic representations for parents' and children's utterances, we used the dependency grammar framework (Tesnière, 1959). Part-of-speech (POS) tags for each token within an utterance were automatically derived using Stanza (Qi, Zhang, Zhang, Bolton, & Manning, 2020), an open-source natural language processing library; dependency relations for all utterances were acquired also in an automatic fashion using DiaParser (Attardi, Sartiano, & Yu, n.d.), a dependency parsing system that has been demonstrated to achieve excellent performance for at least written texts in English.

With our parsed data set, we consider seven communicative functions of negation shown in Table 1 and analyzed negative constructions that convey each of these functions at both the syntactic and discourse level. At the syntactic level (e.g. (1)), give each communicative function, we characterized the syntactic features of the negative utterances associated with the function, then selected cases based on these features in a rule-based fashion with the help of POS information and syntactic dependencies. In addition, to further investigate the developmental paths of negation within specific constructions (that are not necessarily negative), besides negative utterances, we also examined the production trajectory of positive counterparts to the negative constructions; the positive utterances share the same syntactic features (e.g. same head verb) with their negative counterparts except with no negative morphemes. Note that the positive constructions evidently do not

[1] Code and data are in quarantine at https://github.com/zoeyliu18/Negative_Constructions.

express the communicative function as their negative counterparts do; our main purpose of including the positive structures is to provide better control and direct contrast for analyses of the negative constructions.

(1) Rejection at the syntactic level: negative: *I don't want to go*; positive counterpart: *We want to try*

(2) Rejection at the discourse level: Parent: *Do you (not) want to go*; Child: *No I like here*

At the discourse level, on the other hand, we aim to analyze utterances where the negative morphemes are discourse response variables instead. To do that and in order to alleviate potential parsing errors, instances starting with any of the negative morphemes that are discourse response variables with a dependency relation *discourse* were included (e.g. (2)). In this case, utterances such as "no no I like it" were selected. Then for each negative utterance identified this way, we extracted its previous utterances in the discourse context based on the utterance order and transcript id provided by childes-db. In particular, for child speech, we included interactions (contextual utterances + current negative utterance) where the contextual utterances were produced by either the parents or the children themselves; and for parent speech, we only included interactions where the contextual utterances were produced by children. Then for every function, we applied the same syntactic features for both negative and positive utterances at the syntactic level to the contextual utterance within each discourse interaction. This means that the contextual utterance does not have to be negative.

Measures

We took the age of the children as the index of developmental stage[2]. Take negative constructions at the syntactic level as an illustration. For each communicative function, we

[2] Utterance length was also applied as another index of developmental stage. For more details....

used the following two metrics at each age as measures of the developmental trajectory in child speech. The first one is the *ratio* of negative utterances. For instance, the number of utterances produced by children at the age of 30 months (not just all negative constructions at this age) is 81,302 in total. Among these utterances, negative structures that have the function of rejection occur for 391 times; the ratio for this communicative function at 30 months is then calculated as 391 / 81,302 = 0.005.

Given the noisy nature of child production data in general, and the facts that there are different numbers of utterances and children at each age, another measure that we utilized is *moving ratio*, borrowed from the model of moving average in analyses of time series data (Wei, 2006). For a communicative function, the goal of the moving ratio is still to reflect the production of the negative utterances at the given age; meanwhile it takes into account the previous production of all negative constructions of the same function before the specified age. This would allow us to have a more balanced look at individual developmental stage (e.g. age) of a communicative function, in relation to its development patterns thus far.

The computation of the moving ratio is as follows. For instance, given that the number of negative utterances that express rejection in child speech is 391 at the age of 30 months, we: (1) count the total number of negative constructions with the same function produced by children *at and before* 30 months old (2,166); (2) compute the total number of utterances (721,748) within the same age range; (3) divide the number of (1) by that of (2) (2,166 / 721,748 = 0.003).

At the syntactic level, besides the negative constructions, we also calculated the two measures above for their positive counterparts, and extended the measures to discourse interactions at the discourse level.

While our focus is child production, we used parents' speech as comparative references. Therefore for every communicative function, the same measures were calculated for parent

speech in a similar fashion. Our plots accordingly contrast the ratios / moving ratios of different constructions between children's and parents' production at corresponding ages of the children.

In what follows, we describe in detail the results of each communicative function and their negative constructions. While we computed both ratio and moving ratio for every function, our analyses mainly rely on the latter.

Communicative functions of negative constructions and their positive counterparts

Rejection. For the function of rejection, at the sentence level, we examined cases where the lemma of the head verb of the phrase is either *like* or *want*. For negative constructions, the head verb is modified by one of the three negative morphemes, whereas cases including the same head verb but without negation were determined as the positive counterparts. Therefore the positive utterances do not necessarily have large lexical overlap with the negative structures. With negative utterances, other than expressions that the speakers used to describe their own desires with (e.g. (1)) or without (e.g. (2)) an auxiliary verb, we also included cases that express rhetorical inquiries of desires from one interlocutor addressed to another (e.g. (3)), and instances where the speaker is describing the desires of somebody else (e.g. (4)). This resulted in a total of 20,641 negative utterances (child: 9,398; parent: 11,243), and a total of 180,881 negative utterances (child: 63,427; parent: 117,454).

(1) negative: *I no like sea* ; positive: *she likes cheese*

(2) negative: *don't wanna go* ; positive: *I want it*

(3) negative: *don't you wanna try it* ; positive: *I wanna have that*

(4) negative: *Sarah doesn't like that either* ; positive: *she likes this one*

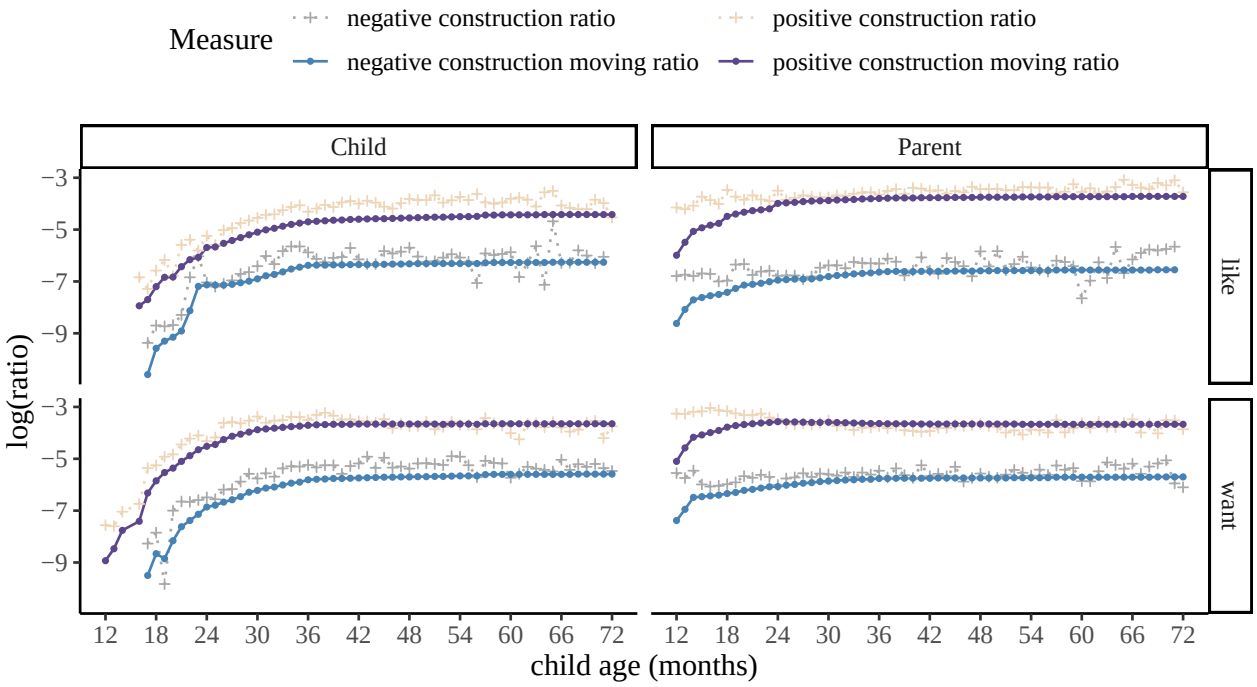

Figure 1. Rejection and its positive counterparts

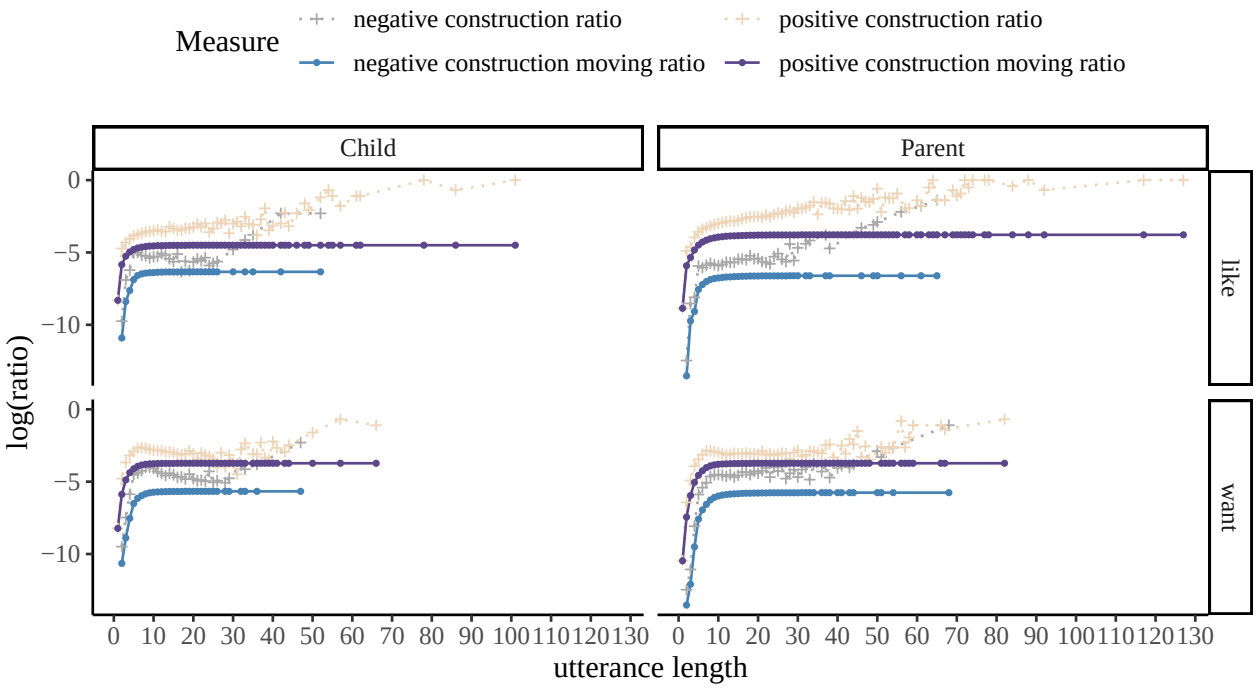

Figure 2. Rejection and its positive counterparts, indexed by utterance length

As presented in Figure 1, at the sentence level the overall pattern for children's usage

of negative morphemes for rejection is comparable regardless of the particular head verb. Comparing child and parent speech, it seems that children's production of rejection is gradually increasing between the age of 18 to 36 months. And the production moving ratio in child speech appears to be more comparable to that of parent speech after 28-30 months. Across the age range the production ratio for negative utterances is consistently lower than that for their positive counterparts.

On the discourse level, we investigated discourse interactions (contextual utterance + current negative utterance) in which the contextual utterances have a head verb of *like* or *want*, yet the head verb does not have to be modified by negative morphemes (e.g.). This resulted in a total of 1,957 utterances (child: 994; parent: 963).

As shown in Figure 2, children's production of negation as discourse response variables increases regularly from the age of 24 - 36 months[3]. Overall negative morphemes are applied at the discourse level more frequently in child speech compared to that in parent speech.

(6) Parent: *I want you to try it*; Child: *no no no*

(7) Parent: *would you like to go*; Child: *no no*

(8) Child: *I don't like that*; Parent: *no honey you have to try it*

[3] For each communicative function, at the discourse level we also examined cases of different subtypes (e.g. different head verbs) separately; though due to data sparsity issues, we collapsed these instances for final analyses

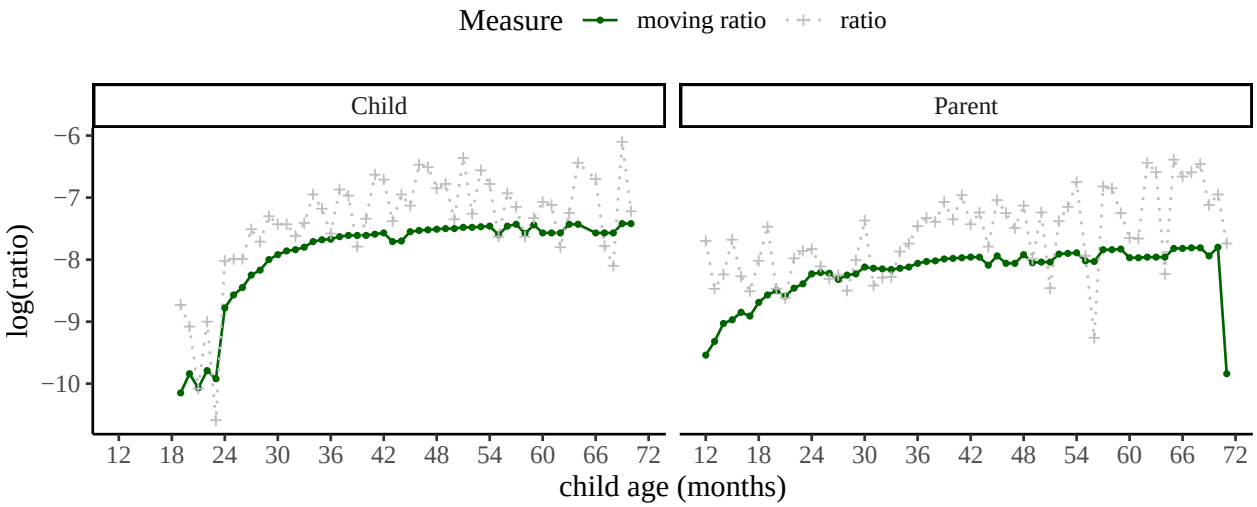

Figure 3. Discourse-level Rejection

Non-existence. For the function of non-existence, we first extracted utterances that have expletives marked by *there* in which the predicate is a nominal phrase (headed by either nouns or pronouns). Cases where the predicate is modified by negation were considered negative utterances, and the rest were analyzed as positive constructions. This led to a total of 1,987 negative utterances (child: 498; parent: 1,489), and a total of 35,390 positive utterances (child: 8,398; parent: 26,992).

(5) negative: *there's no (more) water* ; positive: *there are books*

(6) negative: *there isn't it* ; positive: *there is it*

In child speech, the production of negative constructions to express non-existence at the syntactic level is consistently less frequent than their positive counterparts. The moving ratio of negation for this function is gradually increasing from 25 to 36 months (Figure), which is by contrast later than that for the communicative function of rejection presented in Figure 1. This observation does not seem to align with Bloom (1970), which initially proposed that the development of non-existence is earlier than that of rejection. On the other hand, children's production moving ratios tend to be consistently lower than that for parent speech at the corresponding ages of the children.

Notice that there appears to be fluctuations of moving ratios between the age of 19 and 25 months regarding child production. A closer inspection of the data reveals that within that age range, the frequency of negative utterances at most ages is either one or zero. Therefore while the number of total utterances increases along the developmental trajectory, the moving ratio for negative utterances actually decreases.

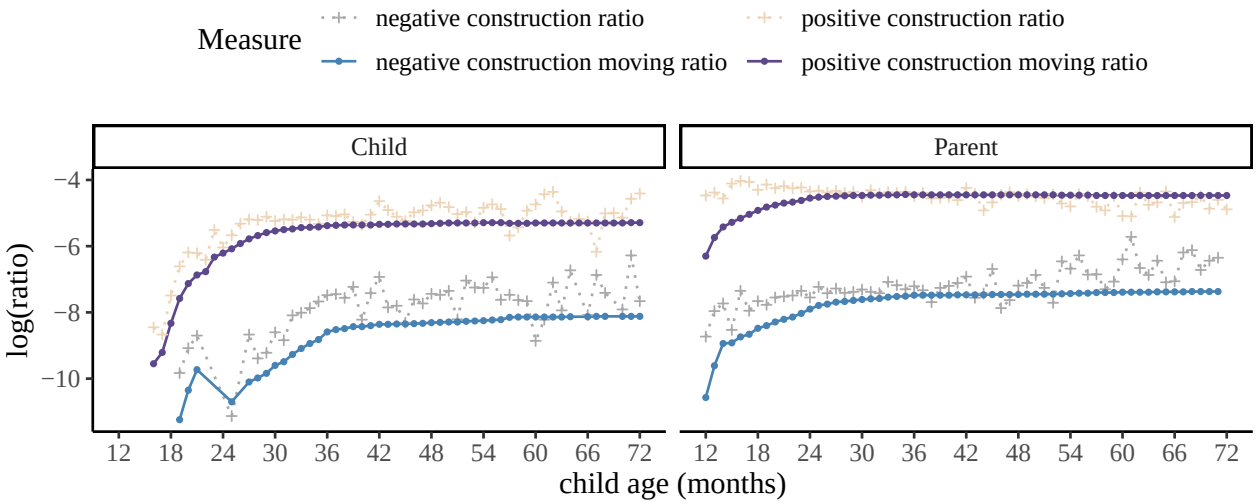

Figure 4. Non-existence and its positive counterparts

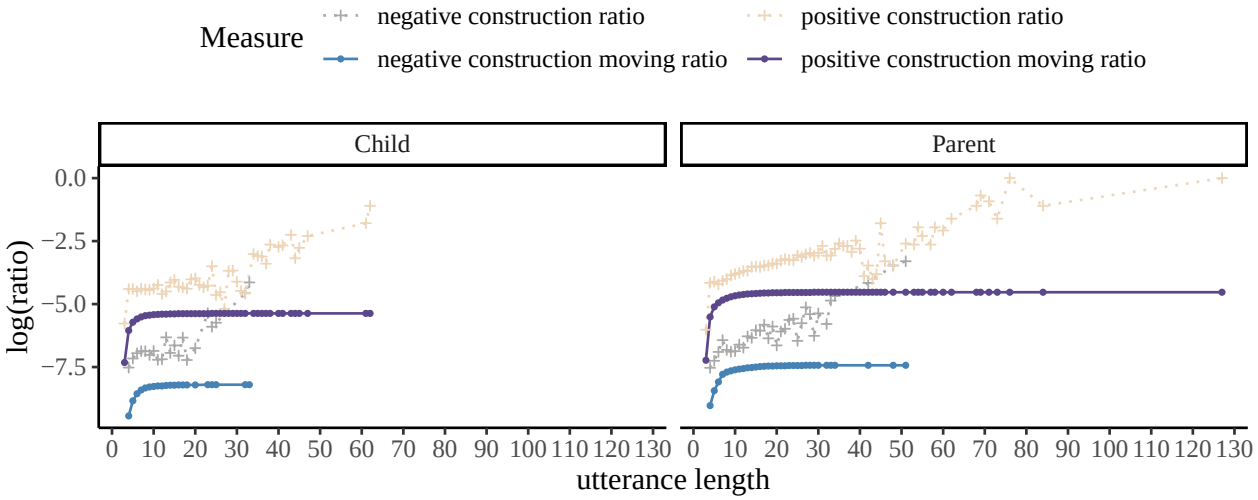

Figure 5. Non-existence and its positive counterparts, indexed by utterance length

For non-existence at the discourse level, we applied similar utterance selection criteria and extracted interactions where the contextual utterance is an expletive structure (e.g.). This led to a total of 221 utterances (child: 91; parent: 130). Given Figure , the developmental pattern for this communicative function at the discourse level bares similarities to that at the syntactic level. The production of negation as discourse response variables also increases regularly from 24 to 36 months, meanwhile gradually approaching the

moving ratio of parent speech around 34-36 months.

() Parent: *Is there a bunny*; Child: *no no bunny*

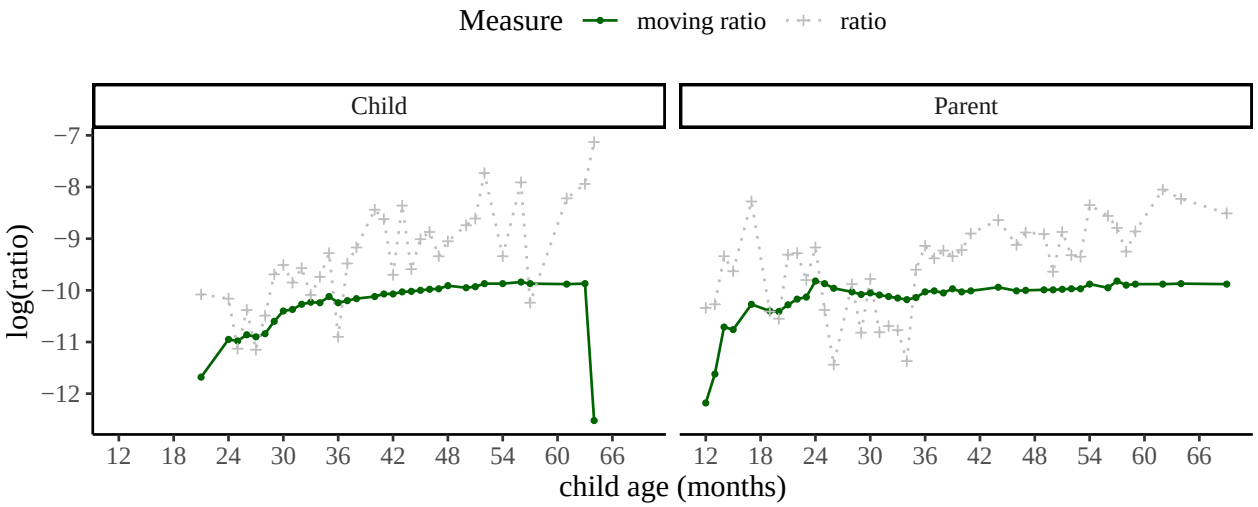

Figure 6. Discourse-level Non-existence

Prohibition. For constructions that articulate the function of prohibition, we focused on cases that are annotated as imperatives from the initial CHILDES annotations. In particular, we selected instances where the head verbs do not take any subjects. Cases without negative morphemes are considered as positive structures. For negative constructions, we chose structures where the negative morphemes are combined with the auxiliary verb *do* (*do*, *does*, *did*) and they together modify the head verbs of the sentences. In order to not overlap with rejection, non-existence, epistemic negation and possession (see below), our search excluded utterances where the head verb has any of the following lemma forms: *like*, *want*, *know*, *think*, *remember*, *have*. This resulted in a total of 1,069 negative utterances (child: 309; parent: 760), and a total of 25,542 negative utterances (child: 8,659; parent: 16,883).

Based on Figure 3, in both child and parent speech, the production of negative constructions for prohibition at the syntactic level is consistently lower than their positive

counterparts. Children are combining negative morphemes for this function more and more regularly between 24-36 months, which is comparable to that of the function of non-existence, but slightly later than that of rejection. In comparison, the production moving ratio in parent speech gradually decreases when the children are within 15 - 36 months; yet child production is still consistently lower than that in parent speech at any age of the children.

(7) negative: *don't blame Charlotte* ; positive: *cook it*

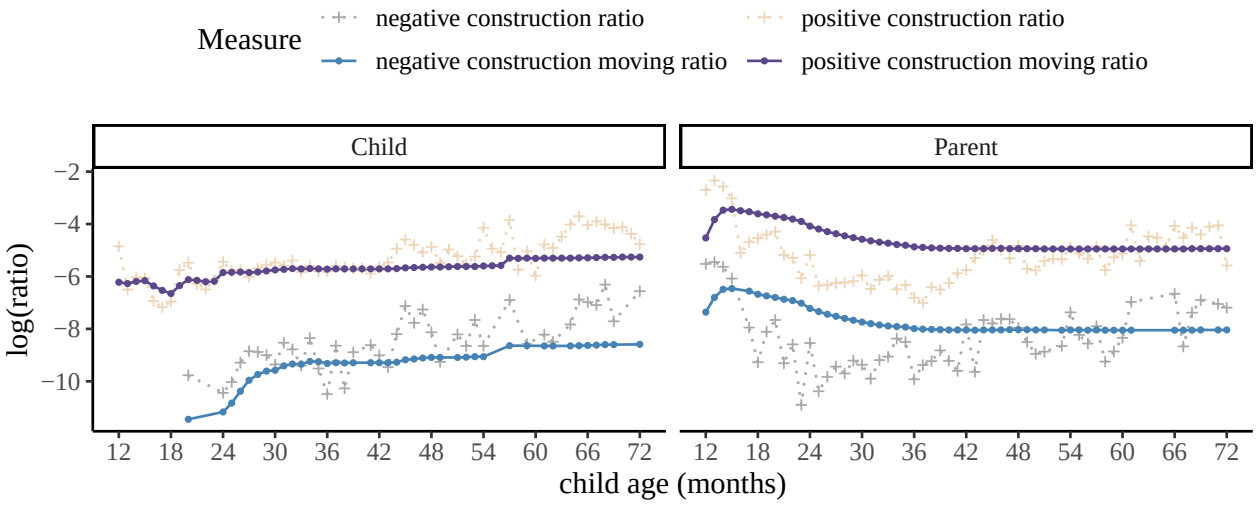

Figure 7. Prohibition and its positive counterparts

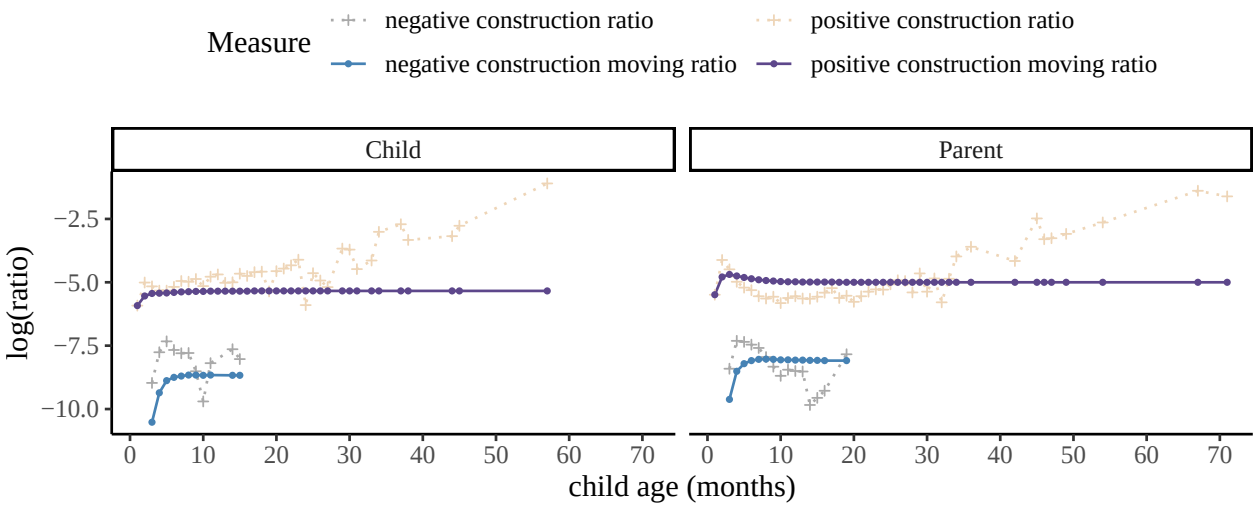

Figure 8. Prohibition and its positive counterparts, indexed by utterance length

When it comes to the discourse level, we took discourse interactions where the contextual utterances are also subjectless imperatives headed by a verb, of which the lemma form is not *like*, *want*, *know*, *think*, *remember*, nor *have*. This resulted in a total of 238 utterances (child: 8,968; parent: 17,643).

As shown in Figure , children's usage of negation as response variables to express prohibition is comparable to that at the sentence level: the production in child speech increases within the age range of 24 to 36 months. and parent production decreases when the children are between 15 to 36 months.

() Parent: *put away your toys*; Child: *no mommy I like these*

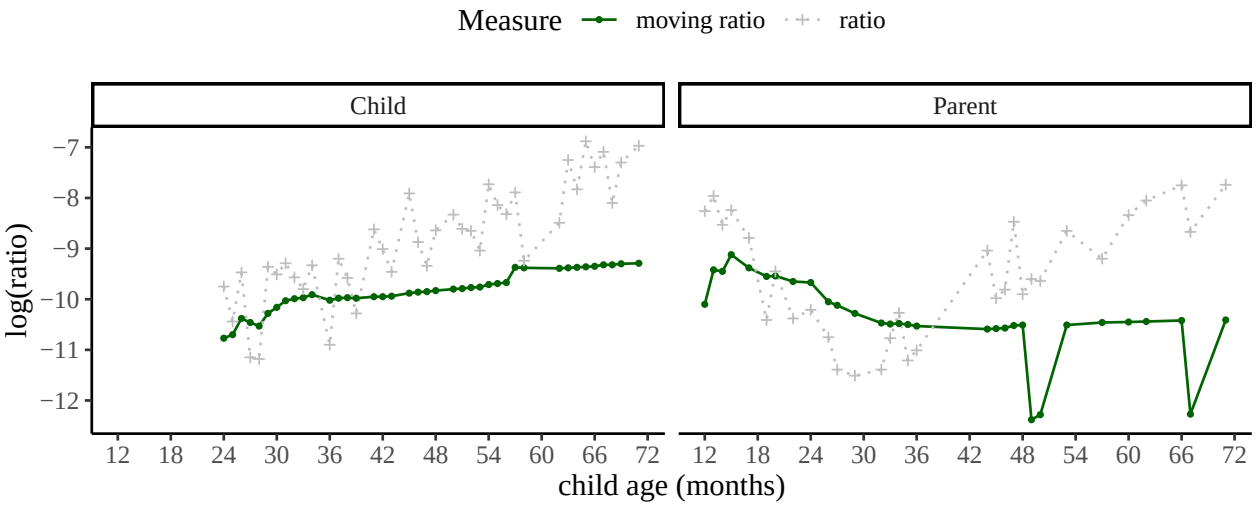

Figure 9. Discourse-level Prohibition

Inability. For the function of inability, at the syntactic level, we analyzed instances with head verbs that are modified by the auxiliary *can* (*can* and *could*; e.g. ()). Structures in which the head verbs are also modified by negative morphemes are determined as negative while the others are considered positive. Cases without a subject (e.g. "can't play") or where the subject is not *I* (e.g. "you can't do that") could yield ambiguous readings when not looking at a larger discourse context; they could be a rhetorical question or also express the concept of prohibition. Therefore to potentially avoid less ambiguity, we restricted our analyses only to cases with a subject *I*. This led to 7,115 negative utterances (child: 3,917; parent: 3,198), and 14,433 positive utterances (child: 7,589; parent: 6,844).

(8) negative: *I can't see* ; positive: *You could do it*

As shown in Figure , the developmental trajectory of inability at the sentence level is similar to that of rejection. Negation is applied more and more regularly between 18-36 months. By contrast, it is different from those of non-existence and prohibition. It seems that the production trajectories of the latter two are both becoming more regular at a later age (25 and 24 months, respectively). Overall the production of negative structures is less frequent than their positive counterparts in both child and parent speech.

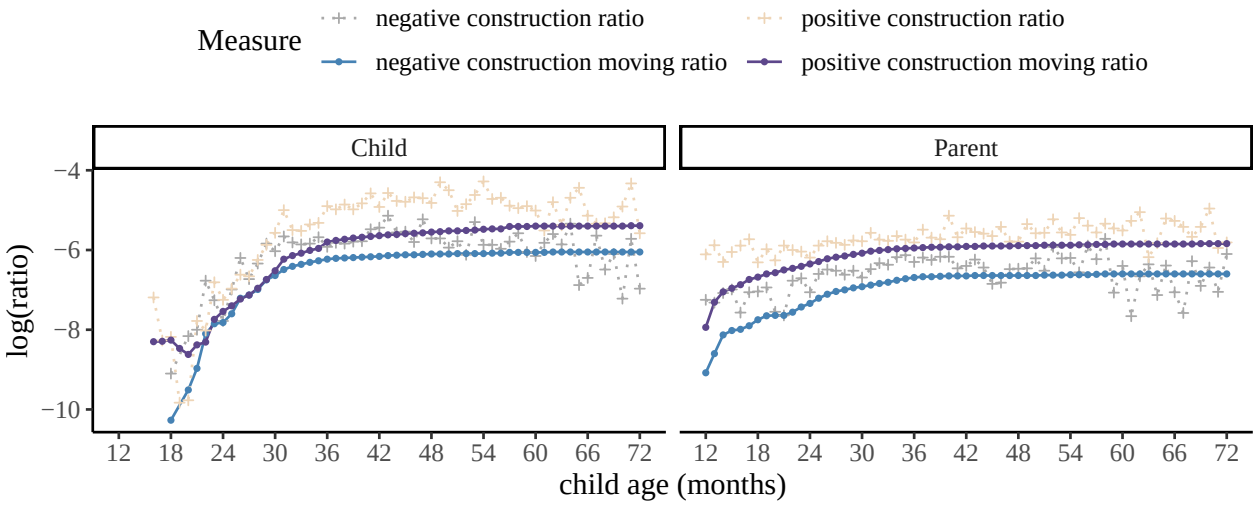

Figure 10. Inability and its positive counterparts

For inability at the discourse level, we analyzed interactions where negation is applied to respond to contextual utterances in which the head verbs take the auxiliary *can* or *could* along with the subject *I*. This yielded a total of 313 negative utterances (child: 11,506; parent: 10,042).

Looking at Figure , children's production of inability at the discourse level gradually increases from 24 to 36 months. By contrast parents' production decreases from the age of 15 to 36 months, which is similar to parent production of prohibition at the discourse level.

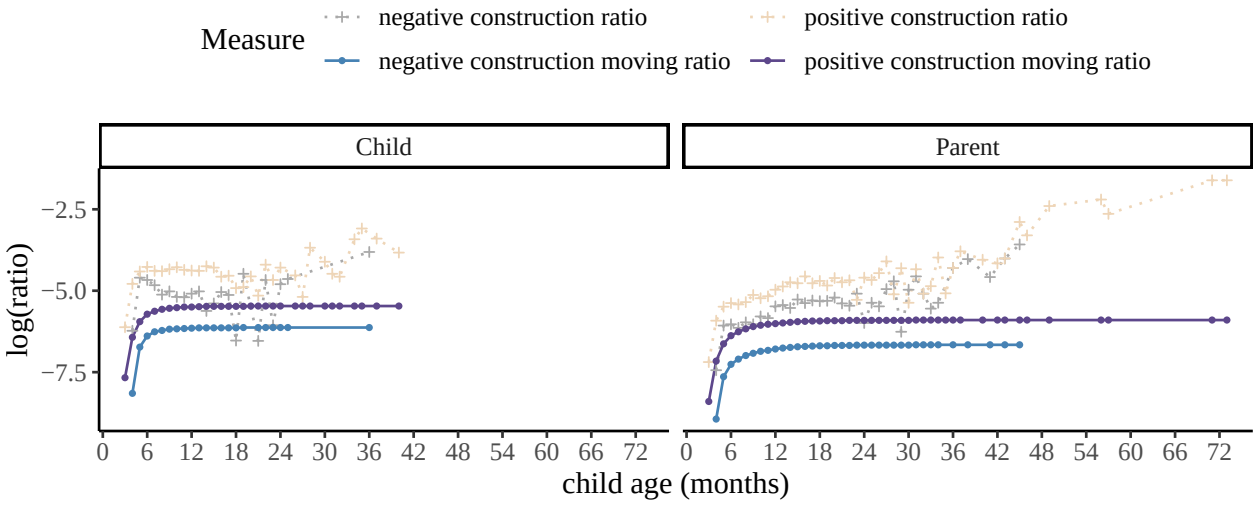

Figure 11. Inability and its positive counterparts, indexed by utterance length

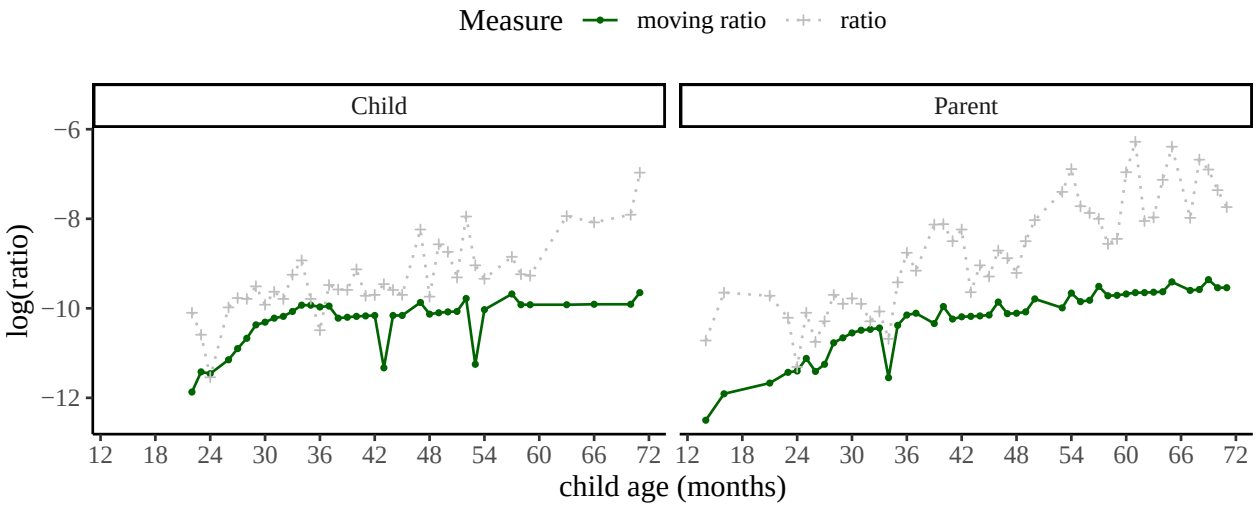

Figure 12. Discourse-level Inability

Labeling. To capture the function of labeling at the sentence level, we concentrated on copula structures in which the predicate is a nominal or an adjectival phrase. Specifically, the nominal predicates exclude possessive pronouns in order to not be confused with cases for the communicative function of possession (see below). Instances where the predicate is modified by negative morphemes are deemed negative, and the others are positive structures. None of the utterances contained expletives (e.g. "there is no book") to distinguish from non-existence. This resulted in a total of 36,410 negative utterances (Child: 6,193; Parent: 30,217), and 484,679 positive utterances (Child: 121,107; Parent: 363,572).

(9) negative: *that's not a farmer* ; positive: *this is a book*

(10) negative: *I'm not a heavy baby Mum* ; positive: *it's a nice bowl*

(11) negative: *It's no good* ; positive: *she's pretty*

Based on Figure 5, the developmental pattern for labeling at the sentence level is comparable to rejection; children are increasing their use of the negative morphemes around the age range of of 18-36 months. In both child and parent production, the frequency of positive counterparts is consistently higher than that of the negative structures. Overall, parent's production of negation for labeling is also comparatively higher than that in child's production across the different ages of the children.

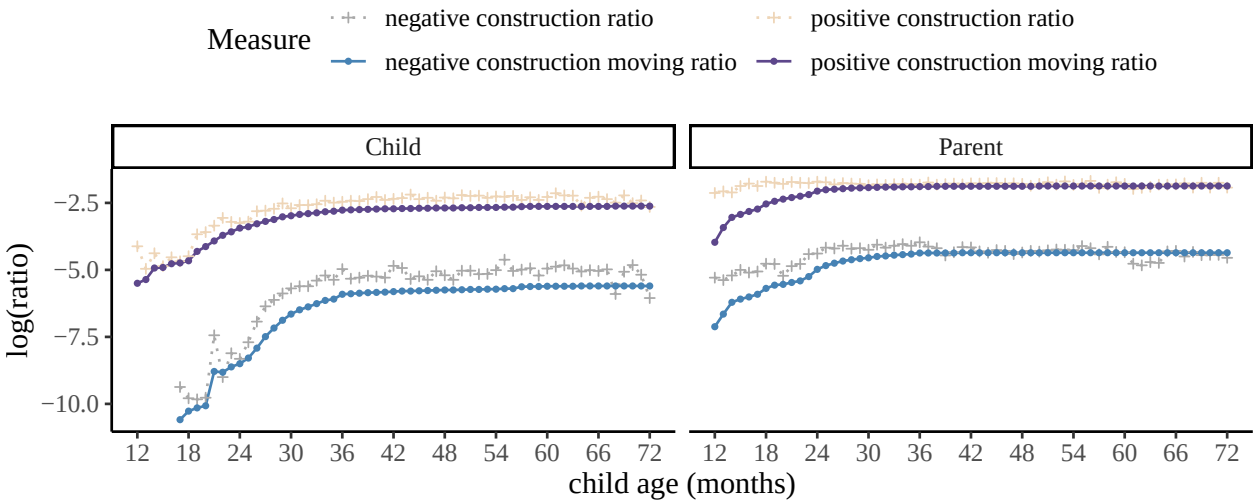

Figure 13. Labeling and its positive counterparts

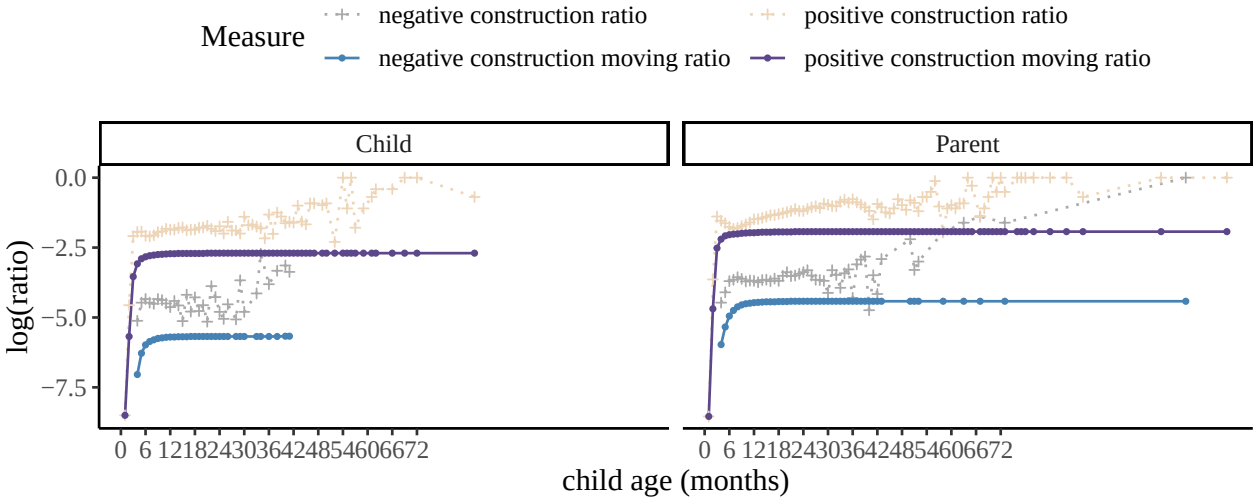

Figure 14. Labeling and its positive counterparts, indexed by utterance length

On the discourse level, we examined interactions where the contextual utterances are copula structures with a nominal or an adjectival predicate. This resulted in 4,079 utterances (Child: 2,234; Parent: 1,845). Based on patterns from Figure , it seems that children more regularly use negation as response variables to express labeling between 18 to 36 months; child's production frequency gradually approaches that in parent speech around the age of 30 - 32 months.

351 () Child: *that's the one*; Parent: *no it's the green one*

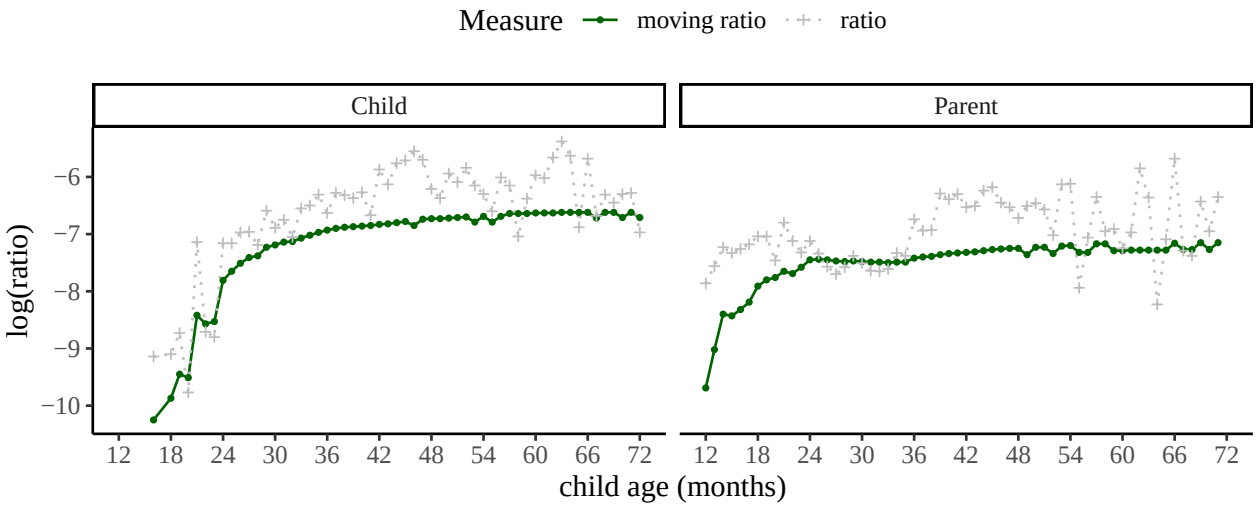

Figure 15. Discourse-level Labeling

Epistemic Negation. Previous studies have reported instances where negative morphemes are combined with mental/epistemic state verbs such as *know*, *think*, and *remember* in child speech to express epistemic negation. Here we focused on these three verbs as well. For the sentence level, we analyzed negative utterances that articulate the concept of not knowing (e.g. (12)) or uncertainty (e.g. (13)). The verbs in these cases are modified by the negative morphemes directly or by the combination of negation with auxiliaries. Instances where the speaker asks about or describes the negative epistemic state of another speaker (e.g. (14)) were also selected, leading to 31,696 negative utterances in total (child: 9,852; parent: 21,844). For the positive counterparts, we selected instances with the same head verbs except that these verbs are not modified by negation. This resulted in a total of 95,679 negative utterances in total (child: 16,322; parent: 79,357).

(12) negative: *I not know / I didn't remember*; positive: *I knows*

(13) negative: *I don't think so*; positive: *I think this one is good*

(14) negative: *don't you remember / She doesn't know this*; positive: *She knows about this*

Based on the data analyzed here (Figure), for epistemic negation at the syntactic level, the production of negative utterances headed by *know* is comparatively the highest, and is becoming more regular at an earlier age (17-18 months) compared to that of *remember* (~19 months) or *think* (~20 months). Overall the production moving ratio of negative utterances is relatively lower than that of the positive structures. Across the three head verbs, it appears that child's production with *know* and *remember* gradually approaches that in parent production around 34 - 36 months, whereas cases with the head verb *think* tend to be produced less frequently in child speech.

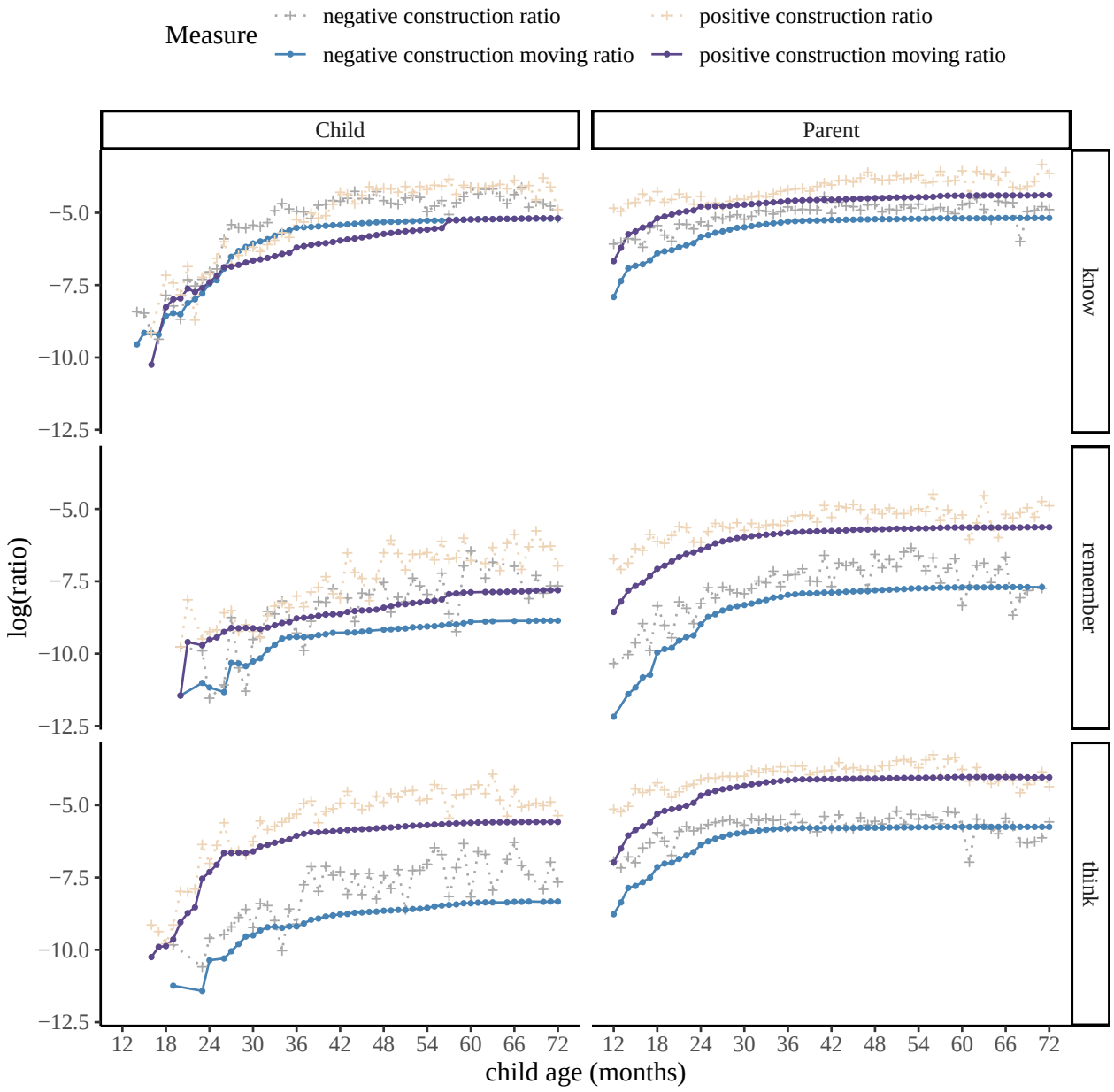

Figure 16. Epistemic negation and its positive counterparts

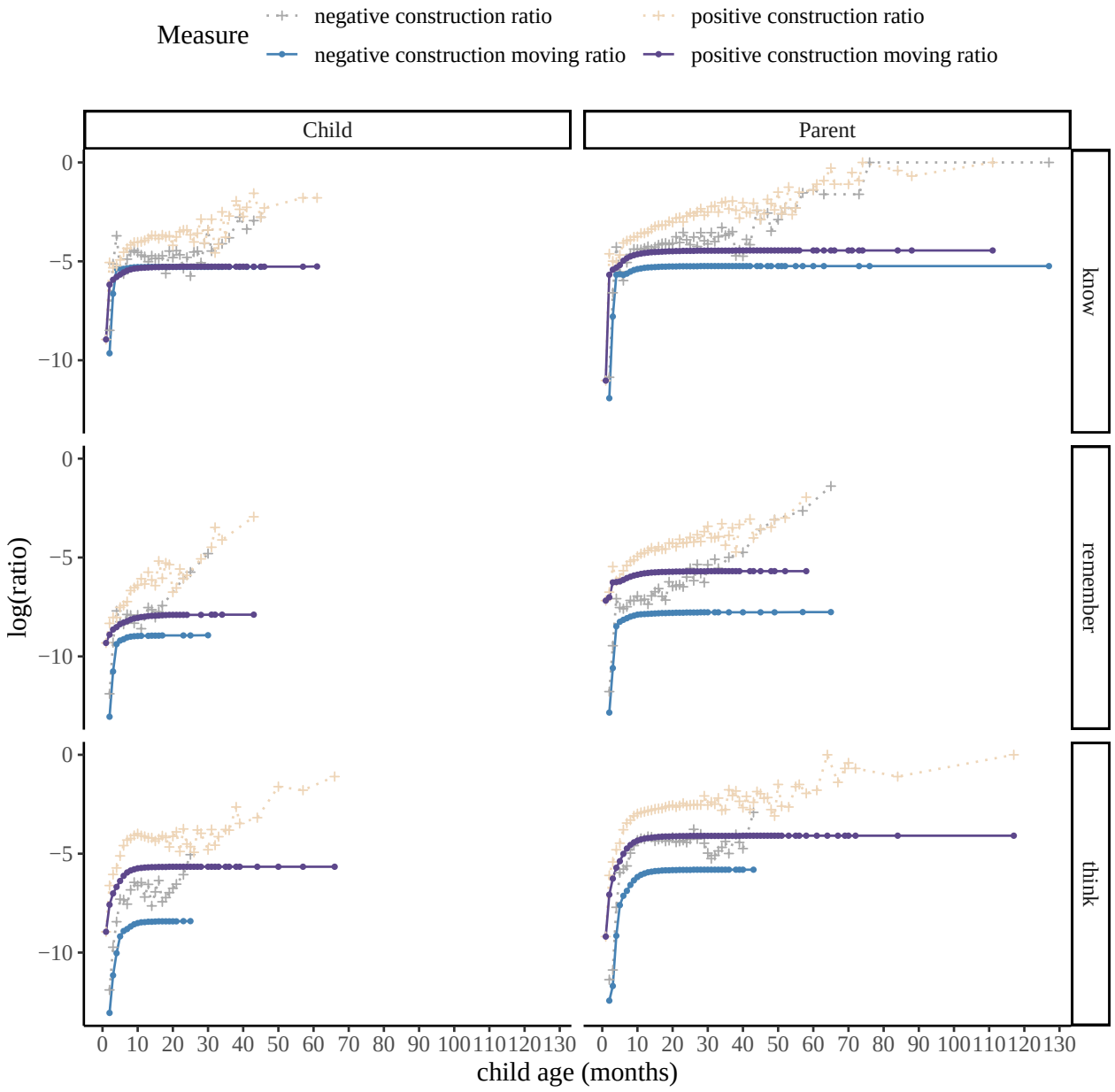

Figure 17. Epistemic negation and its positive counterparts, indexed by utterance length

For epistemic negation at the discourse level, we examined interactions in which the contextual utterances take any of the three head verbs, *know*, *remember* and *think*, leading to a total of 985 utterances in total (child: 26,174; parent: 101,201). The developmental trajectory of child speech from Figure demonstrates a gradual increase of production moving ratio from 24 to 36 months.

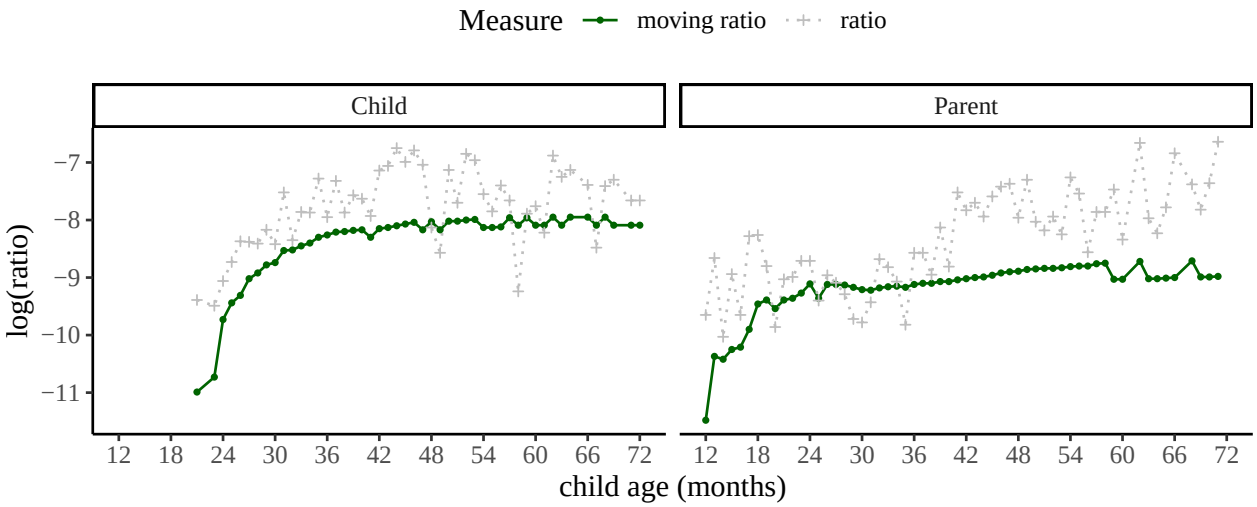

Figure 18. Discourse-level Epistemic Negation

Possession. The last function we explored is possession. At the syntactic level, for negative structures we selected cases where the negative morphemes are combined with auxiliary verbs to modify a head verb with the lemma form *have* and a POS tag of VERB (e.g. (15)). We also included individual noun phrases with possessive pronouns as heads and modified by negative morphemes (e.g. (16)). Cases in which the syntactic head of the negative morphemes is a predicate of a copula verb (e.g. "this is not mine") were excluded to separate them from the function "labeling." The number of negative utterances that were subjected to analysis for this function is 9,025 (child: 2,852; parent: 6,173). Again the positive counterparts share similar structures except with no negation, leading to a total of 8,230 (child: 6,062; parent: 2,168). One thing to note here is that for the positive structures with the head verb *have*, we restricted to cases where the verb takes a direct object (with the dependency relation *obj*). This is to avoid potential parsing errors of instances such as *I have*, where the verb could ambiguously be an auxiliary.

(15) negative: *I don't have it*; positive: *you have that*

(16) negative *not mine*; positive: *hers*.

Given Figure 7, at the sentence level, the developmental trajectory for possession in child speech appears to have notable differences depending on what the negative morphemes are modifying. When their syntactic head is *have*, the pattern is comparable to those of "rejection" and "labeling," where children are increasing their combination of negative morphemes from 18 to 36 months. However, the production moving ratio for utterances headed by possessive pronouns seems to be relatively stable across different ages.

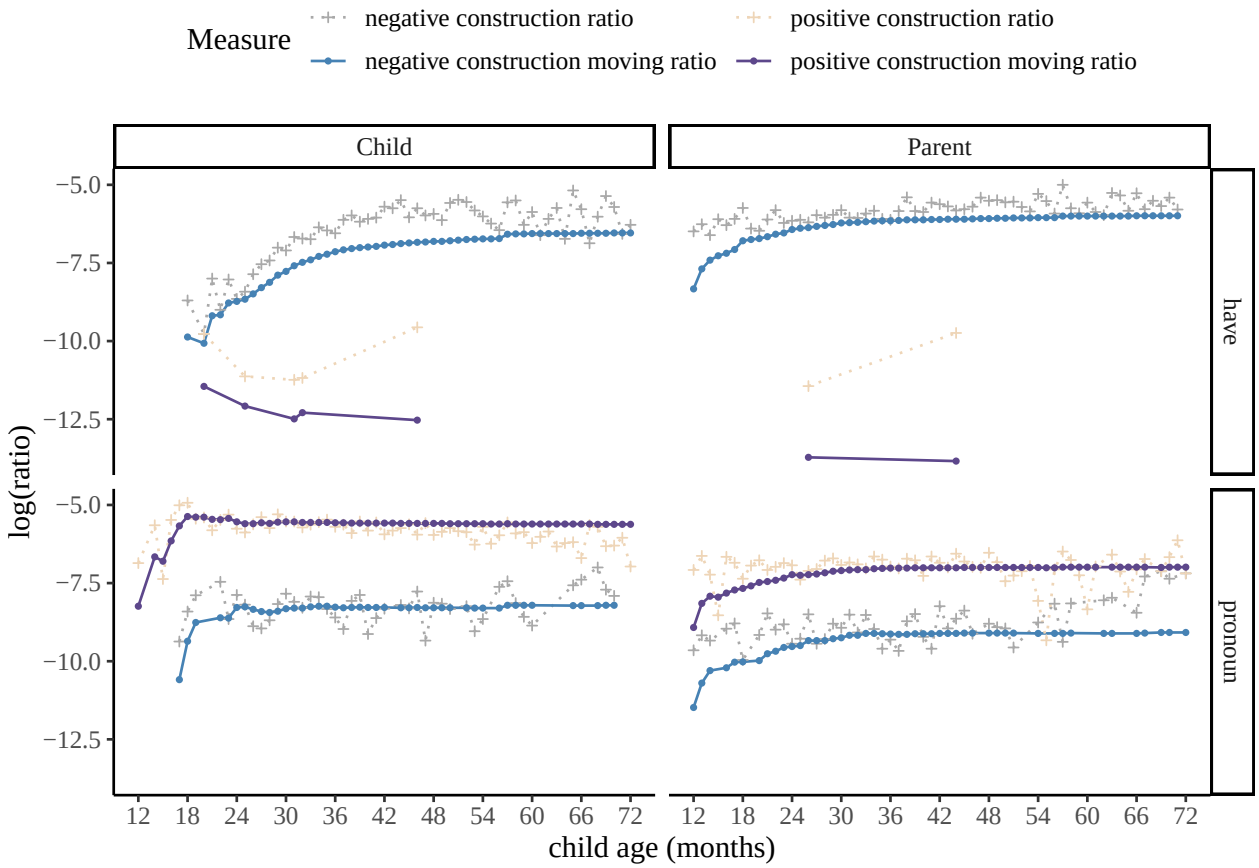

Figure 19. Possession and its positive counterparts

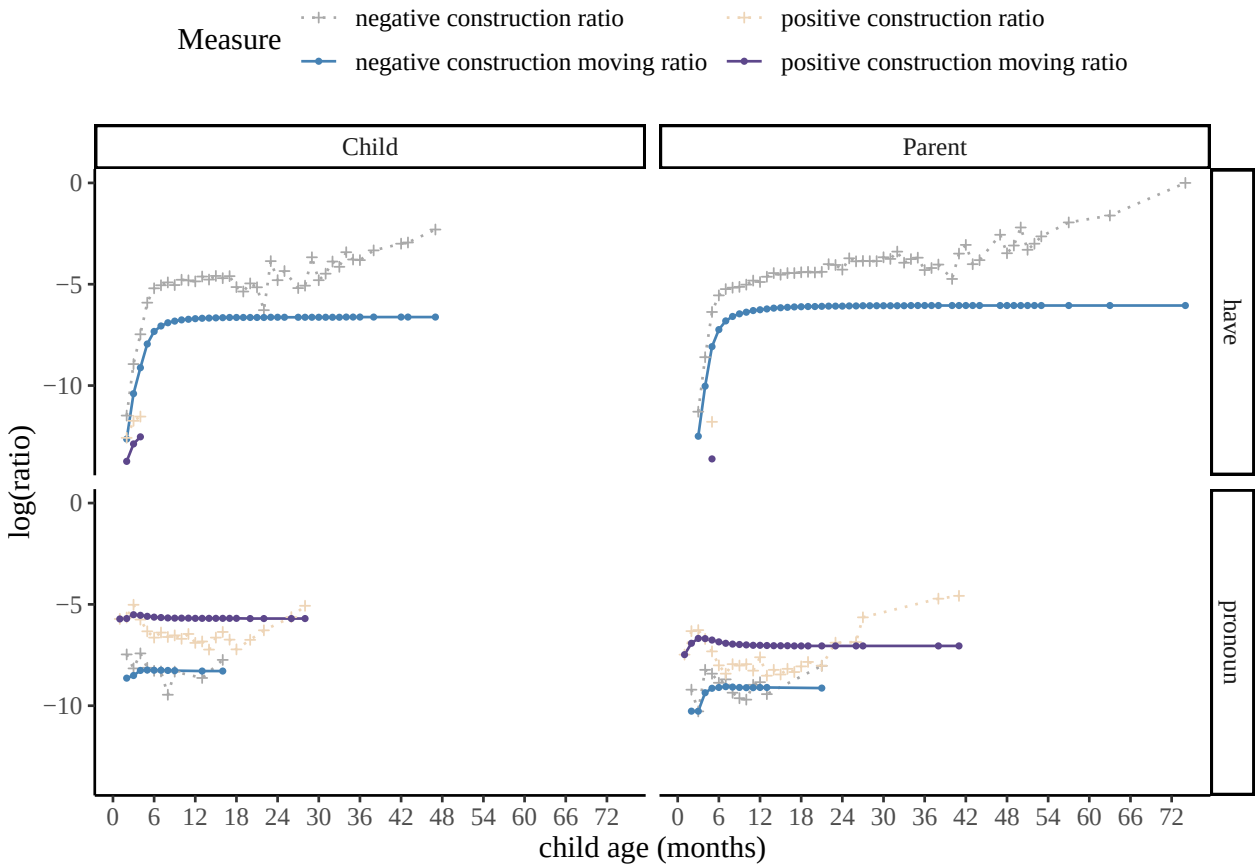

Figure 20. Possession and its positive counterparts, indexed by utterance length

For the discourse level, we selected interactions in which the contextual utterances have similar structural features to both the negative and the positive constructions at the syntactic leve.

() Parent: *I don't have the book*; Child: *no no mommy please read it to me* () Parent: *not yours*; Child: *no it's mine mine*

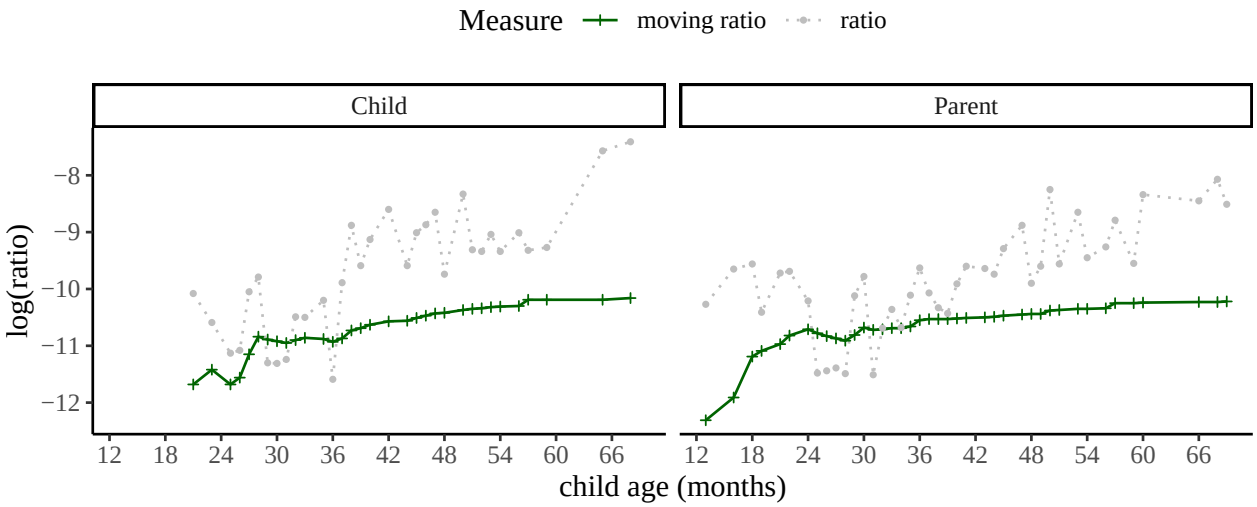

Figure 21. Discourse-level Possession

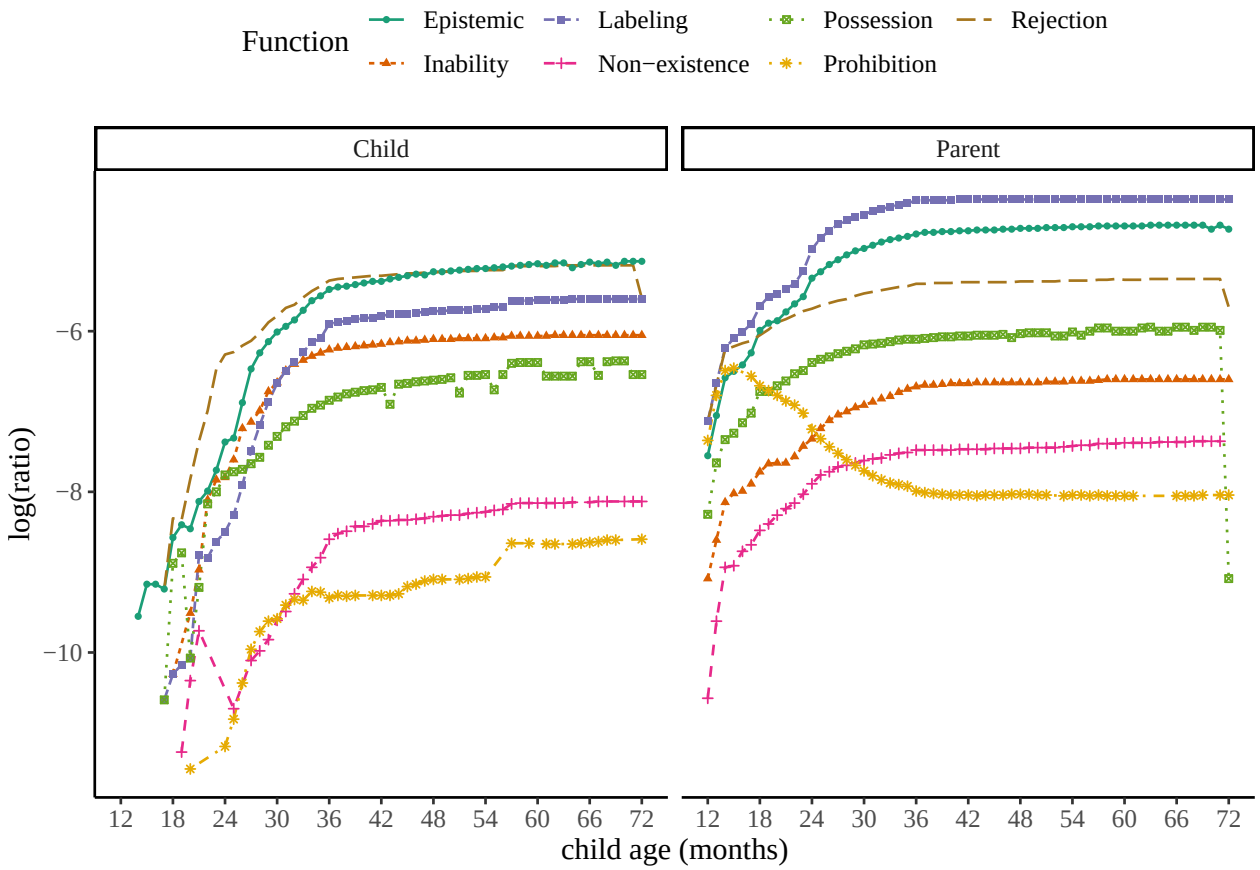

Figure 22. All negative constructions at the syntactic level

405 **An overall look.**

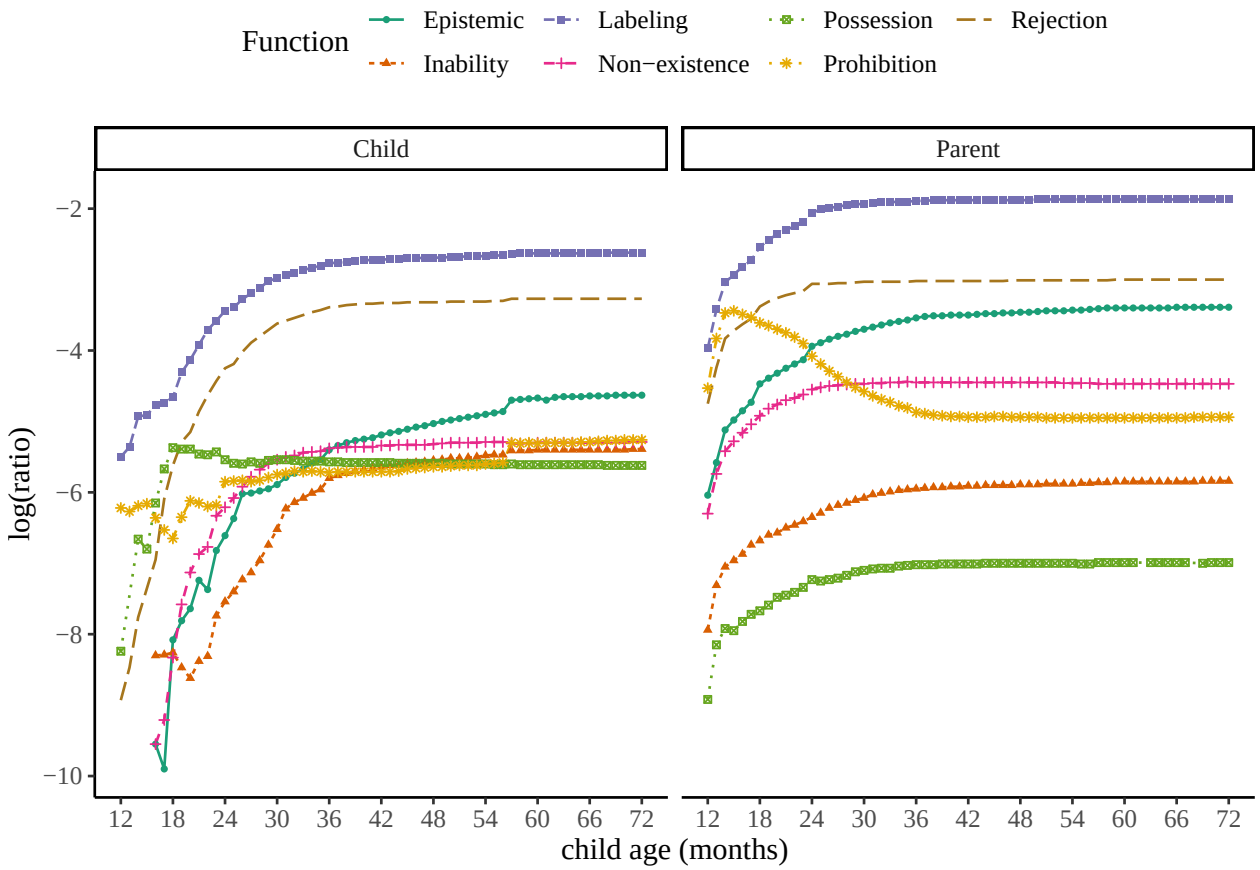

Figure 23. Positive counpterparts of all negative constructions at the syntactic level

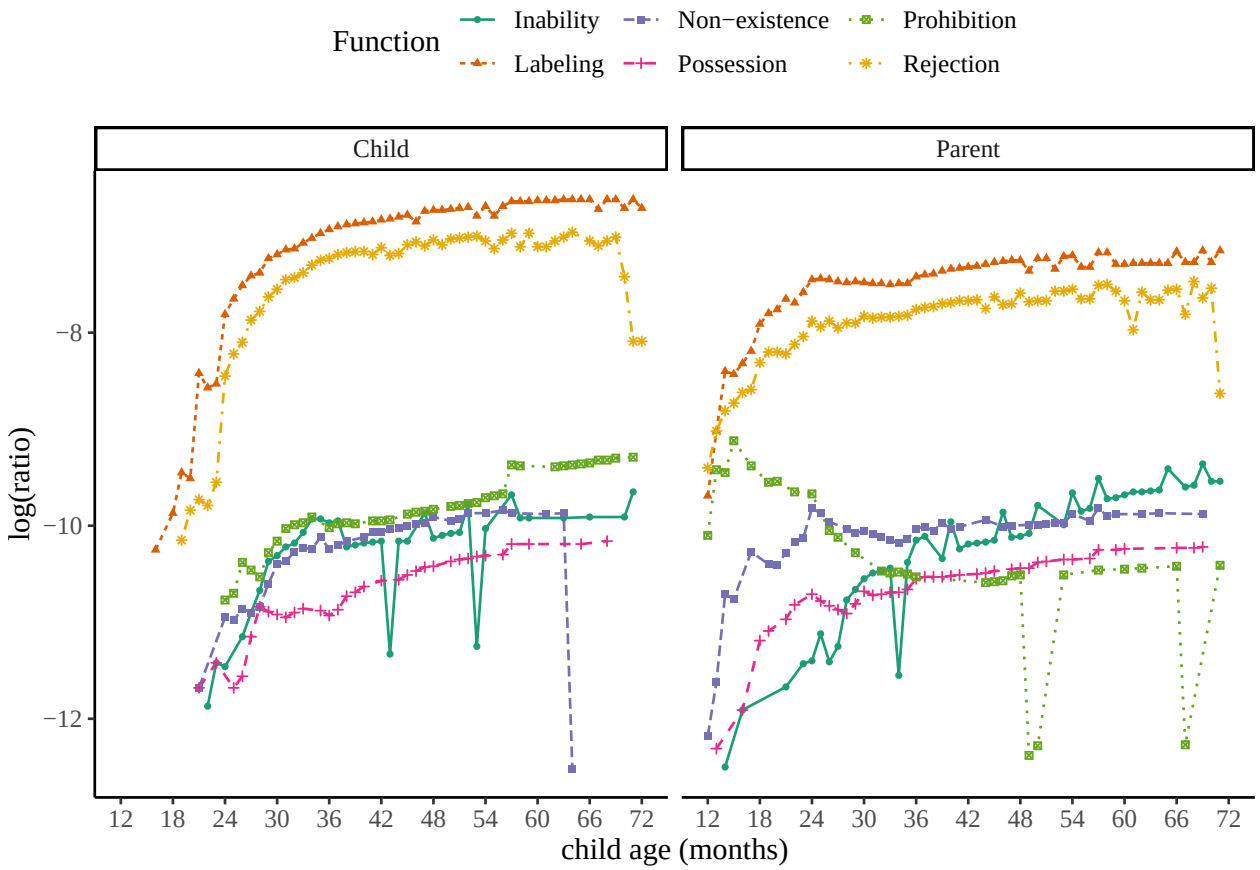

Figure 24. All functions at the discourse level

Discussion

Using automatic annotations of large-scale corpora of child-parent interactions, we presented production trajectories for seven negative constructions that tend to express rejection, non-existence, prohibition, inability, labeling, epistemic states, and possession (Table 1). The results suggest that the production of almost all these negative constructions (except for prohibition) emerges and gradually increases within the 18-36 months age range (Figure 8). Their production frequencies remain stable and regular after 36 months and relatively close to parents' levels of production. It is important to note that similar to prior studies, our conclusions are limited to negation in children's production. Systematic experiments testing children's comprehension of negative utterances with different

communicative functions are necessary to better understand the origins and developmental trajectory of negation.

For future work, we would like to explore several directions. First, to more thoroughly examine and potentially model the developmental trajectories of negation in child production, certain production-specific factors (e.g. length of utterance, ease of pronunciation) should be taken into account as well. In addition, we aim to investigate the production trajectory of positive counterparts to our negative structures (e.g. "I know" for "I don't know"). Comparisons of negative utterances in relation to their positive counterparts would allow us to further analyze the developmental paths of negation within specific constructions.

Lastly, our experiments have concentrated on larger syntactic structures at the utterance level, hence cases where negation is used as discourse markers to respond to previous utterance(s) were excluded. However, these instances also have important semantic and conceptual roles in the communication between children and parents (e.g. parent: *do you want some bread?*; child: *no no no*). Thus inclusions of negative structures at a more comprehensive level would be able to paint a more clear picture about the development of negation.

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Function	**Linguistic Composition**	**Examples**
Rejection	with *like* or *want*	*I not like it*; *not want it*
Non-existence	expletives	*there is no soup*
Prohibition	with imperative subjectless *do*	*do not spill milk*
Inability	with modal *can*	*I cannot zip it*
Labeling	modifying nominal or adjectival predicatives	*that's not a crocodile*; *it's no interesting*
Epistemic negation	with *know*, *think*, *remember*	*I not know/think/remember*
Possession	with *have*; or possesive pronouns	*not have the toy*; *not mine*

Table 1

Communicative functions of negation in early child language of English.