

English Negative Constructions and Communicative Functions in Child Language

Anonymous CogSci submission

Abstract

How does negation emerge in early conceptual and linguistic development? Previous research has hypothesized that negation develops to express communicative functions such as rejection, non-existence, or prohibition. However, findings from prior work have mostly relied on manual annotations to identify negative utterances of different functions, leading the number of children as well as the size of the data sets analyzed to be relatively small. This study considers specific syntactic constructions combined with negative morphemes (*no*, *not*, *n't*) in English as expressions of different communicative functions for negation. Leveraging large-scale corpora of child-parent interactions along with computational tools, we examine the developmental trajectories of seven different functions and their corresponding negative constructions. Our analyses demonstrate a gradually increasing usage of negation in all functions between the ages of 24 - 36 months; yet there are notable differences in the earlier developmental stages of negation depending on the particular function investigated.

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

Introduction

Negation is an abstract concept crucial to everyday communication. It can help a coffee shop divide its menu into “coffee” and “not coffee” sections, with the “not coffee” section bringing together diverse items with no common label. It can inform us to regulate each others’ actions in a sign like “no mask, no entry”. It can also communicate our deepest wants and dislikes as in “I don’t like Mondays”. But how does the abstract concept of negation emerge in the human mind? What are the specific communicative functions that negation combines with in early language development?

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 have 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 express “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 have 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 et al., 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 have remained unclear. Different studies have claimed different order of acquisition (Pea, 1978). In a recent study, Nordmeyer & 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 have 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.

Our study addresses this question by using syntactic constructions as a proxy for communicative functions. We used a large collection of child speech corpora in English (MacWhinney, 2000) with part of speech tags and syntactic dependency relations. We automatically selected constructions that conveyed the functions discussed in prior research and asked: (1) how early do these constructions emerge in children’s speech and what’s their trajectory? (2) within the same communicative 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?

Q1: How does the developmental trajectory of each communicative function look like? Q2: How do the developmental trajectories of different communicative functions vary?

Mention in Introduction (and/or connect in Experiments section after things are finalized): these negative constructions do not cover everything that negation could be combined with, and that the negative constructions are not the only ways of conveying different communicative functions

Experiments

Data and preprocessing

For developmental production data of child language in English, we turned to the CHILDES database (MacWhinney, 2000).¹ We focused on speech produced by children with typical development within the age range of 12 - 72 months, specifically at the single-sentence level (as opposed to the discourse level). Utterances of child and parent speech were extracted via the *chilides-db* (Sanchez et al., 2019) interface using the programming language R. Negative structures were then identified based on whether a structure contains any of the three negative morphemes: *no*, *not* and *n’t*. Since

the matters of interest here are syntactic structures *combined* with negation, cases consisting of one negative morpheme (e.g. *no!*) or repetition of negative morphemes (e.g. *no no no!*) were not considered.

In order to conduct analysis of negative syntactic constructions and the particular communicative functions that they serve, we need to first obtain (morpho)syntactic representations of child and parent speech. To do that, we opted for the dependency grammar framework (Tesnière, 1959); the syntactic dependency relations of all negative utterances were automatically derived with DiaParser (Attardi, Sartiano, & Yu, n.d.), a dependency parsing system that has been demonstrated to achieve excellent performance for English. And to further facilitate identifications of negative constructions, we also utilized the available part-of-speech (POS) information initially provided by CHILDES (Sagae, Davis, Lavie, MacWhinney, & Wintner, 2010) when necessary.

Besides the functions of rejection, non-existence, prohibition, inability and labeling (the sub-function of denial), we expanded with two other functions: epistemic negation (Choi, 1988) and possession (see Table 1). For each function, using our parsed data set, we characterized the syntactic features of the negative constructions associated with that function. Based on these features, negative utterances were automatically extracted in a rule-based fashion with the help of POS information and syntactic dependencies.

Measures

As indexes of the developmental trajectory for negative constructions and their communicative functions in child speech, we measured the following two metrics at each given age of the children. 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 52,491 in total. Among these utterances, negative structures that have the function of inability occur for 141 times; the ratio for this communicative function at 30 months is then calculated as $141 / 52,491 = 0.003$.

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 inability in child speech is 141 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 (682); (2) compute the total number of utterances

¹Code and data are in quarantine at <https://github.com/zoeyliu18/Negative.Constructions>.

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

Table 1: Communicative functions of negation in early child language of English.

(419,949) within the same age range; (3) divide the number of (1) by that of (2) ($682 / 419,949 = 0.002$).

While our focus is negative utterances in child production, we used parents' speech as comparative references. Therefore for every communicative function, the same two ratio measures were calculated for parent speech in a similar fashion. Our plots accordingly contrast the ratio / moving ratio of different negative 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

Rejection For the function of rejection, we examined cases where the lemma of the head verb of the phrase is either *like* or *want*, and the head verb is modified by one of the three negative morphemes. Each of the utterances either takes a subject or has no subject at all. And the existence of a subject was determined via searching for a word in the utterance that has the *nsubj* dependency relation with the head verb.

Additionally, other than expressions that the speakers used to describe their own emotion, with (e.g. (1)) or without (e.g. (2)) an auxiliary verb, we also included cases that express rhetorical inquiries of emotions from one interlocutor addressed to another (e.g. (3)) as well as instances where the speaker is describing the emotion of somebody else (e.g. (4)). Overall our data extraction resulted in a total of 17,436 negative utterances (child: 7,395; parent: 10,041).

(1) *I no like sea*

(2) *don't wanna go*

(3) *don't you wanna try it*

(4) *Sarah doesn't like that either*

As presented in Figure 1, within the context of the corpus data that we analyzed, 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 19 to 36 months. And the production moving ratio in child speech appears to be more comparable to that of parent speech after 32-34 months.

Non-existence For the function of non-existence, in order to not confuse with the function of labeling (see below), we extracted utterances that have expletives marked by *there*

(e.g. (5) and (6)), and that the predicate modified by the negative morphemes is a nominal phrase (headed by either nouns or pronouns). This led to a total of 1,611 negative utterances (child: 406; parent: 1,205).

(5) *there's no (more) water*

(6) *there isn't it*

In child speech, the production of negative constructions to express non-existence is gradually increasing from 27 to 36 months (Figure 2), which is by contrast later than that for the communicative function of rejection presented in Figure 1. This is 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 ratio gradually approaches that in parent speech at 36-38 months.

Notice that there appears to be fluctuations of moving ratios between the age of 19 and 27 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.

Prohibition For constructions that articulate the function of prohibition, we focused on cases that are annotated as imperatives from the initial CHILDES annotations. These utterances do not take any subject; 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 cases where the head verb has any of the following lemma forms: *like, want, know, think, remember, have*. This resulted in a total of 938 negative utterances (child: 267; parent: 671).

Based on Figure 3, children are combining negative morphemes for prohibition more and more regularly amid 24-36 months, which is comparable to that of the function of non-existence, but later than that of rejection. This finding contrasts the proposal from Choi (1988), which suggested that the development of these three functions *starts* around similar time. In comparison, the production moving ratio in child speech for prohibition is consistently lower than that in parent speech at any age of the children.

(7) *don't blame Charlotte*

Inability For the function of inability, we analyzed instances where the negative morphemes co-occur with the aux-

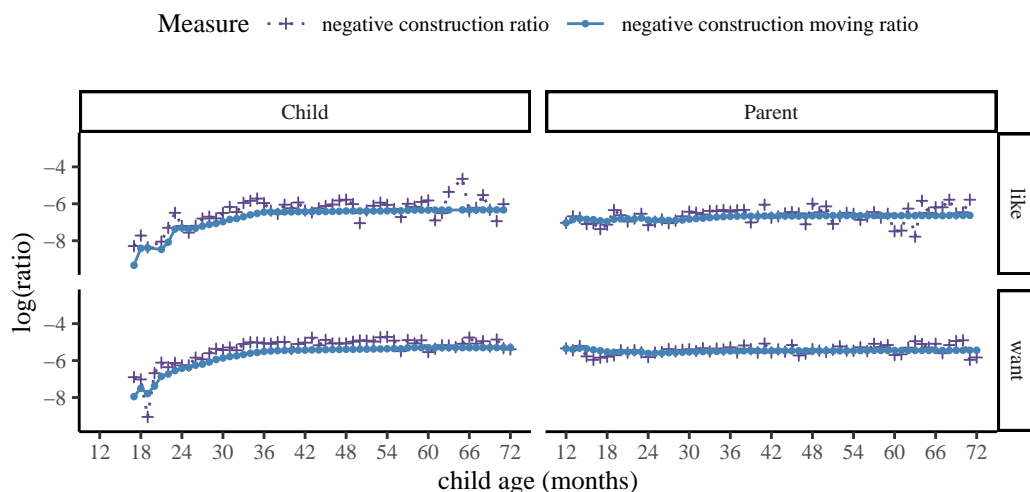


Figure 1: Rejection.

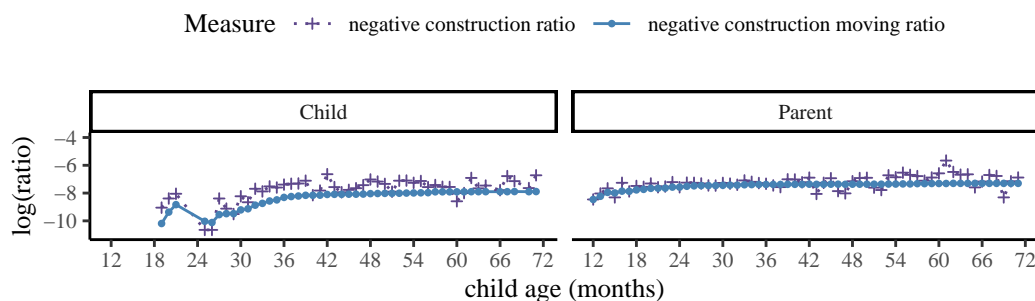


Figure 2: Non-existence.

iliary *can* (*can* and *could*; e.g. (8)) and both of them modify the head verbs of the utterances. Again, we filtered out cases where the head verbs are the focus for other functions. 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 taking a larger discourse context into account; 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 6,369 negative utterances (child: 3,237; parent: 3,132).

(8) *I can't see*

As shown in Figure 4, the developmental trajectory of inability is similar to that for rejection; negation is being applied more and more regularly between 19-36 months. By contrast, the pattern for inability is different from those of non-existence and prohibition in the settings that we investigated. It seems that the production trajectories of the latter two both are becoming more regular at a later age (27 and 24 months, respectively), an observation different from the original argument by Choi (1988), which proposes vice versa.

Labeling To capture the function of labeling, we concentrated on cases where negative morphemes are adopted to indicate the identity (e.g. (9)), and/or characteristics (e.g. (10))

of a predicative nominal. In addition, we also included instances where the negative morphemes are used to modify a predicative adjective (e.g. (11)). Following these criteria, utterances where the negative morpheme is modifying a nominal or adjectival predicate of a copula verb were extracted. None of the utterances contained expletives (*there is no book*) to distinguish from non-existence. This yielded in a total of 32,474 negative utterances (Child: 4,180; Parent: 28,294).

(9) *that's not a farmer*

(10) *I'm not a heavy baby Mum*

(11) *It's no good*

Based on Figure 5, the developmental pattern of for labeling is comparable to non-existence and prohibition; children are increasing their use of the negative morphemes around the age range of 22-36 months.

Epistemic negation The function of epistemic negation was originally discussed by Choi (1988). Although there has been no proposal for negation originating in children's understanding of their own or others' epistemic/mental states, previous studies have reported many instances where the negative morphemes are combined with mental state verbs such as *know*, *think*, and *remember* in child speech. Here we focused on these three verbs and analyzed utterances that ar-

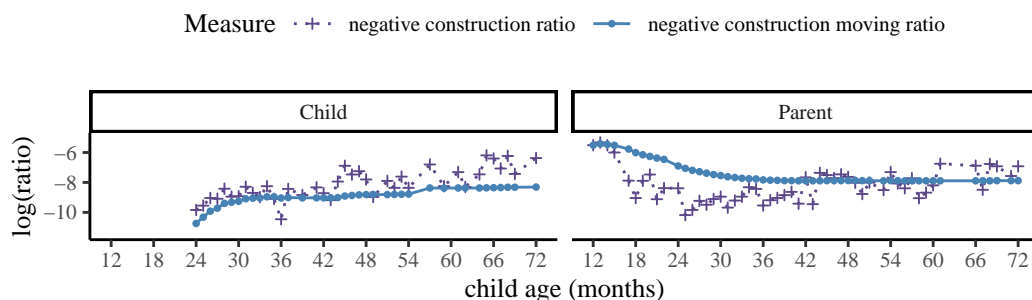


Figure 3: Prohibition.

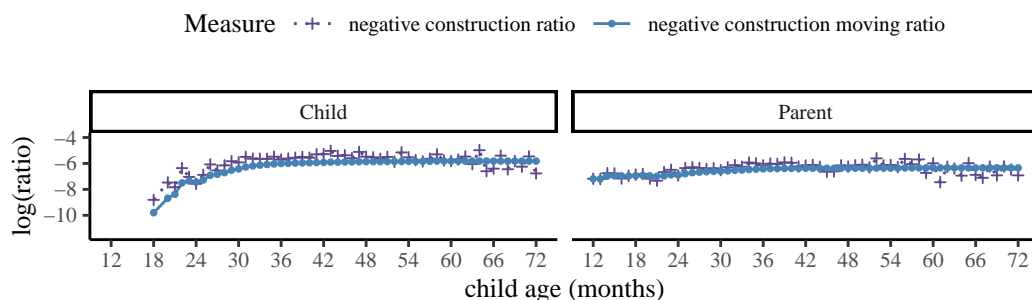


Figure 4: Inability.

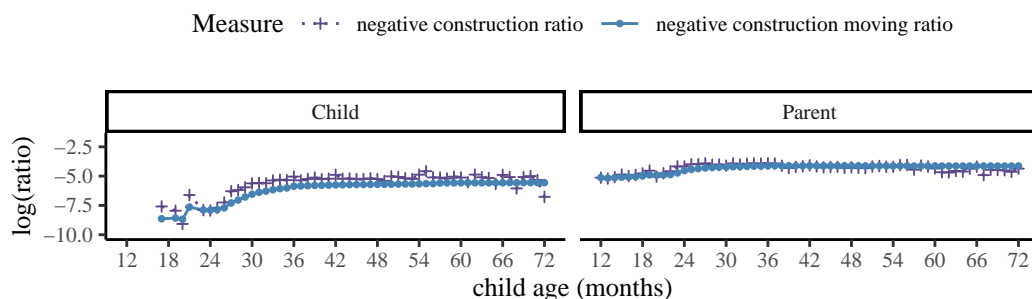


Figure 5: Labeling.

ticulate the concept of unknowing (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. By these search criteria, instances where the speaker inquires about/describes the negative epistemic state of another speaker (e.g. (14)) were also selected, leading to 21,844 negative utterances in total (child: 4,074; parent: 17,770).

(12) *I not know / I didn't remember*

(13) *I don't think so*

(14) *don't you remember / She doesn't know this*

Based on the data analyzed here (Figure 6), comparing the developmental trajectories of labeling with the three head verbs in child speech, the production of negative utterances headed by *know* are 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

utterances with *know* is comparatively the highest.

Possession The last function that we investigated includes negative utterances that denote possession. Specifically, we selected cases where the negative morphemes are combined with auxiliary verbs to modify a head verb with the lemma form *have* (e.g. (15)). We also included instances that are individual noun phrases, where the heads of the noun phrases are possessive pronouns modified by negative morphemes (e.g. (16)). Therefore 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 from the function of labeling. The number of negative utterances that were subjected to analysis for this function is 8,187 (child: 2,331; parent: 5,856).

(15) *I don't have it*

(16) *not mine*

Given Figure 7, the developmental trajectory for posses-

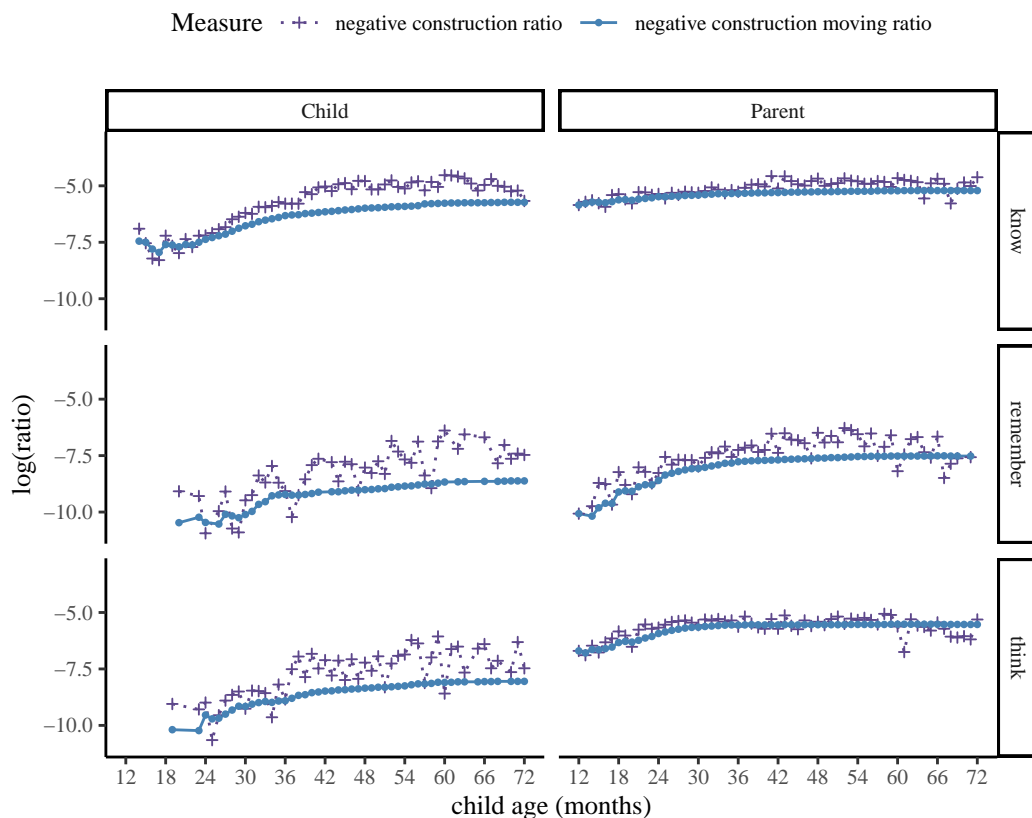


Figure 6: Epistemic negation.

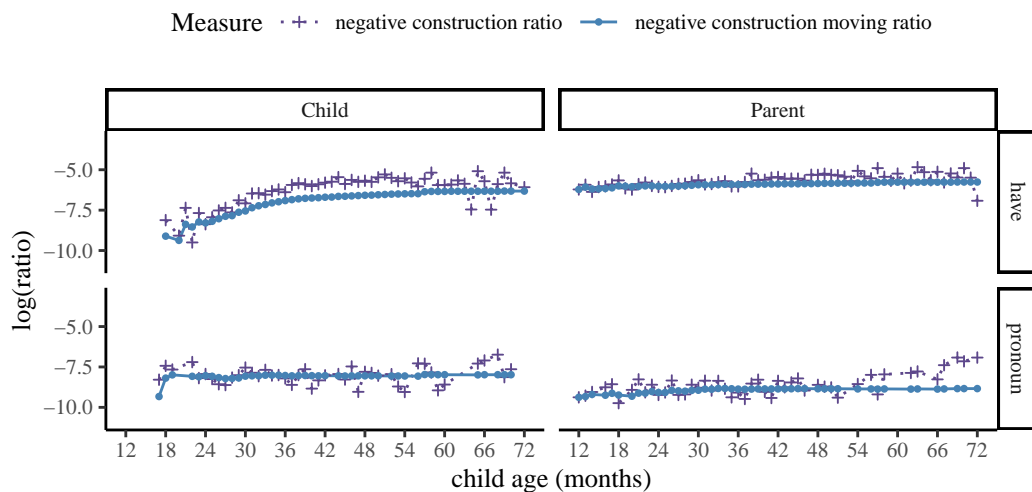


Figure 7: Possession.

sion 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 the functions such as rejection and labeling, where children are increasing their combination of negative morphemes from 19 to 36 months. However, the production moving ratio for utterances headed by possessive pronouns seems to be relatively stable across different ages of the children.

Discussion

With large-scale corpora of child-parent interactions as well as automatic annotations, we presented analyses of negative utterances that express the communicative functions of rejection, non-existence, prohibition, inability, labeling, epistemic states and possession. Taking an overall look at the developmental trajectories of all functions combined shown in Figure

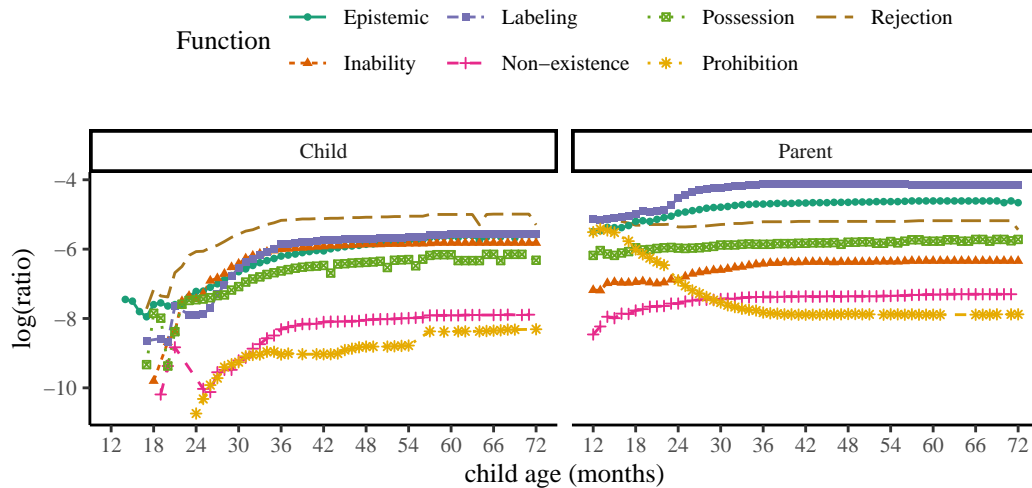


Figure 8: All functions; ratio measured plotted here are moving ratios.

8, it appears that for most of these communicative functions, the usage of negation is gradually increasing between the age range of 24-36 months, and stays regular afterwards.

It is important to note that similar to prior studies, our conclusions are limited to children's production. While it is possible that patterns in children's production reflect their comprehension and semantic development overall, this is not guaranteed. Systematic experiments testing children's comprehension of negative utterances with different communicative functions are necessary to understand the origin of negation more thoroughly. And the data presented in our experiments could be useful stimuli for experiments as such.

For future work, we would like to explore several directions. First, one limitation of our work here is that to more thoroughly analyze and potentially model the developmental trajectories of child production, certain production-specific factors (e.g. length of utterance, ease of pronunciation) should be taken into account as well, which we plan to incorporate in future work. 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*). This would allow us to compare the production of positive and negative constructions and further control for the production trajectory of specific constructions regardless of whether negation is present.

To validate the findings here at a closer angle, we also intend to examine negative utterances produced by individual children with our methods and analyses. Lastly, our experiments thus far have concentrated on syntactic structures at the utterance level, therefore 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 the discourse level would be able to paint a more clear picture about the development of negation.

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