The development of desire language: A corpus study of 'want'

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ABSTRACT

Children's usage of mental state verbs can reveal evidence of their theory of mind and general cognitive development. Children produce a certain class of mental state verbs, namely desire verbs such as *want*, *like*, and *love*, early in development. Among these desire verbs, they produce *want* the most frequently. We report on a corpus study of 450 + instances of *want* as gathered from children's dialogues with caretakers in the CHILDES database. We developed a novel coding scheme to measure children's use and understanding of *want* utterances: i.e., we analyzed the kinds of things that children described wanting for themselves or others, as well as the agents to whom they ascribed desires. We report on the frequencies of these features across the ages of 24 to 59 months (2–4 years of age), and highlight noteworthy trends in the way children used *want*. Children appear to talk about their own desires most often; they primarily use questions to talk about second person desires; and they describe more complex desires as they mature. We describe how these patterns of linguistic competency may serve as an index for the development of mechanisms that underlie mental state reasoning.

1. Introduction

It is possible to understand the nature of children's desires from their language alone – but not at first. The behaviorist B.F. Skinner observed that children can express desires before they acquire language – by clapping, for instance – and that they can co-opt rudimentary verbal expressions (an exclamation such as "water!") to signal what they want. He introduced concepts such as *mand* (as in, "command") and *tact* (as in, "contact") to refer to the factors that motivate such expressions (Skinner, 1957). *Mands* express desires in response to some internal state of deprivation, such as thirst, and *tacts* concern desire expressions based on stimulus from the external environment, e.g., noticing a cup of water nearby. Behaviorist researchers have since debated how interdependent these rudimentary forms of desire expression are on one another (Warren et al., 1984; Wallace et al., 2006; Gamba, Goyos, & Petursdottir, 2015). But since both *mands* and *tacts* can result in the same behavior ("water!"), it is difficult to dissociate the two from observation alone. As this paper will show, once children produce more complex expressions, those expressions become windows into the nature of their desires.

Some of the first verbs that children use are verbs of desire, e.g., *want, like,* and *love*. They produce such verbs before verbs expressing beliefs, e.g., *know, think,* and *forget*. Researchers often compare desire and belief verbs with one another, because they are two of the most basic kinds of *propositional attitude* verbs, which are the verbs used to express dispositions towards statements describing what's true and false, and what's real and possible. The mastery of propositional attitude verbs – also known as *attitude*

verbs or *mental state* verbs – can indicate a maturing theory of mind (Astington, 1993; Astington & Baird, 2005; Baron-Cohen, 1994; Baron-Cohen, 1995; Baron-Cohen et al., 2000; Carruthers & Smith, 1996; Flavell, 1999; Gopnik & Meltzoff, 1997; Leslie, 1994; Perner, 1991; Wellman et al., 1990). Of the various desire verbs, children use *want* the most often, and they start to produce it around age 2 (Ferres, 2003) – perhaps because they may be exposed to the word more often, as in when parents ask about their child's desires. In contrast, belief verbs don't emerge until around 3.5 years of age (Bartsch & Wellman, 1995; Hughes & Dunn, 1999; Jenkins et al., 2003; Lee & Rescorla, 2002; Moore et al., 1994; Ruffman et al., 2002; Shatz et al., 1983; Tardif & Wellman, 2000; see Harris et al., 1996). Children seem to understand *want* in an adult-like way around age 3 but lack a similar mastery of *think* until age 4 (Hacquard & Lidz, 2018; Perner et al., 2003).

Not only do children use and understand desire verbs before belief verbs, but they also – up to age 3 – use desire verbs more frequently than all other mental state verbs (Bartsch & Wellman, 1995; Ferres, 2003; Moore et al., 1994). The reason for this bias is unknown, but perhaps it is utilitarian: children desire things such as food and comfort, yet they are unable to provide for themselves, and so they may discover that speaking about what they want is more effective than crying, gesturing, or other forms of nonverbal communication (cf. Skinner, 1957). In contrast, talking about their beliefs may not yield any obvious advantage in achieving immediate goals.

This paper thus focuses on how children use *want*, as the verb can offer insights into the way children consider hypothetical possibilities. Children develop proficiency of the full meaning of *want* and other expressions of desire as they use them, and mature usage of *want* expresses desire but not intention (Malle & Knobe, 2001; for a theory that distinguishes the two, see Harner & Khemlani, 2022b). Yet children do not appear to distinguish desire from intention until around age 5 (Perugini & Bagozzi, 2004).

Despite the importance of desire verbs and their early emergence, there are few empirical analyses on how young children communicate desire and how their usage of desire language develops. Ferres (2003) studied *querer* 'want' in a corpus of Spanish-speaking children, following a coding scheme developed by Bartsch and Wellman (1995). In particular, the analysis focused on "genuine" references to desire, i.e., usage of the verb that unequivocally indicated some psychological state of wanting that was experienced by the speaker or somebody else. Such genuine desires map roughly to the behaviorist notion of *mands*. More than half of the children's utterances of *querer* were marked as expressing genuine desires (61%), with the remainder coded as non-genuine. For instance, utterances could be coded as requests for an object or action (e.g., "want that doll") and constituted 9% of usage. Bartsch and Wellman (1995) argue that such utterances do not express a genuine desire, but rather a request "to hand that doll to me". Utterances such as *no quiero* '(I) don't want to/it' were marked as idiomatic, accounting for 7% of the *querer* utterances. Other utterances were direct repetitions of adults' *querer* utterances (11%) and were likewise coded as non-genuine. Ferres thus concluded that children appear to use the verb to express a genuine desire as early as 23 months. And by 23 months, the children used *querer* with subjects other than themselves, demonstrating that 2-year-olds recognize that other people have desires.

Pascual and colleagues (2008) likewise studied *querer*, along with a range of other mental state verbs, in a longitudinal corpus they generated by recording 25 Spanish children in their homes from ages 3–5. About half of the utterances that contained mental state verbs used desire verbs, specifically *querer*: *querer* accounted for 50% of all utterances containing mental state verbs, and for 99% of all utterances that contained desire verbs. They coded all instances of *querer* for whether it was genuine or idiomatic (in line with Bartsch & Wellman, 1995; Ferres, 2003); whether the subject of the utterance was the child or another person; the complexity of syntax, e.g., whether *querer* was complemented by something like a relative subordinate clause or a complement clause; and the linguistic diversity of *querer* utterances, e.g., the count of unique words in *querer* utterances. Their notable findings concern the subject of *querer*: similar to previous work, Pascual and colleagues found that children expressed their own desires at a stable rate from ages 3 to 5, while their expression of others' desires increased from ages 3 to 5. But contrary to previous work, the children in their dataset expressed other people's desires more often than they did their own. Unsurprisingly, children used more complex structures for *querer* over time, e.g., around 3.5 years, they began to complement *querer* with a clause rather than just a nominal. In contrast, the children used more complex syntactic structures for belief verbs around ages 4 to 4.5 years. Together, these trends underscore previous claims that children's understanding of desire develops earlier than their understanding of belief.

The literature on *want* and *querer* raises several questions, both theoretical and methodological. The primary theoretical question concerns the constructs tracked in previous analyses: the coding scheme developed by Bartsch and Wellman (2005) does not provide any guidance on how to consider the objects of desire utterances. As a result, research using their scheme does not reveal what desires children express most often. Their desires may be physical, such as for food or toys, or they may be events and actions, whether realistic (e.g., "I want to go to the beach"), imagined (e.g., "I want to see Santa's home"), social (e.g., "I want to be friends with Stacey"), or remembered (e.g., "I want to watch more *Paw Patrol*"). Indeed, children may express desires to engage in events, or else they may desire things for other people to do. Likewise, while the aforementioned coding scheme helped researchers evaluate the "matrix subject" of *want*, i.e., who is doing the wanting in *want* utterances, it does not identify the complement subject of *want*. The two may not be identical: in the sentence, "Max wants Jean to record him", the matrix subject is Max, and the complement subject is Jean. Tracking complement subjects can help assess how often children direct their desires onto actions they can perform versus those that another person must perform. This sophistication may be acquired incrementally, such that the usage of complement subjects increases steadily over early development, or it may come online at a discrete stage.

The syntax of desire expressions likely matures alongside its semantics. For instance, children may have initial difficulty producing utterances in which *want* is negated. Negation is a complex syntactic and semantic construct (see, e.g., Horn, 2001; Khemlani et al., 2012; Orenes, Beltán, & Santamaria, 2014), which can pose difficulties even in adult comprehension (Wason, 1965). Children's comprehension of negation continues to develop after age 3 (e.g., Cameron-Faulkner et al., 2007; Klima & Bellugi, 1966). The role of negation in desire predicates can be subtle: for instance, if it's true that *Ayesha doesn't want a cookie*, then it may be because she wants some cake instead, it may be because she doesn't like cookies, or it may because she is so full that she doesn't want anything more.

These complexities suggest that children might incrementally acquire their understanding of negation and begin to produce it in tandem with desire predicates at an early age. The usage of negated desire predicates may be idiomatic, as in *no quiero* '(I) don't want to/it', i.e., an immutable set of words with a simple, fixed, rapidly interpreted meaning. Alternatively, children may avoid producing negation and desire predicates until later in development, once the concept has matured.

Likewise, previous work has not examined when *want* occurs in interrogative expressions. The usage of desire verbs in questions may serve as a marker for when children can encode other people's desires, and when they recognize that they do not have direct access to those desires. When a child asks, e.g., "Do you want to play with me?" it may be because the child recognizes that their caretaker's desires may conflict with their own. Here, too, it may be that children begin to produce desire questions at a young age, and increase in their productions as they mature, indicating evidence of the incremental acquisition of the semantics of desire. Or, they may avoid interrogatives until their ability to encode other agents' desires has matured.

In this paper, we report an analysis of instances of children's *want* utterances to address whether they incrementally acquire the semantics and syntax of desire, or whether their understanding of the verb *want* matures in discrete steps. We conducted a corpus analysis of child-produced utterances of *want* in the CHILDES database (MacWhinney, 2000), and we developed a novel coding scheme to explore the flexibility and the semantic properties of their usage. We describe how we gathered the data, the methodology we used to code *want* utterances, and discoveries on how usage of *want* develops over time. For instance, we find that children shift from saying *want [nominal]* to *want [clause]*. We show how the results provide evidence for the incremental acquisition of the semantics, but not certain syntactic properties, of *want*; that is, we show which precursor notions of the meaning of *want* grow more sophisticated over early years of language usage. We conclude by discussing what the discovered patterns suggest about children's theory of mind and mastery of linguistic features, and the directions these patterns provide for experimental work.

2. Corpus analysis

Conventional corpus analyses – of *want* utterances as well as of other sorts of utterances – often use coding schemes that focus on the features of a singular utterance devoid of its conversational context. To analyze *want* utterances properly, however, it was necessary to conduct an analysis, not on single utterances, but on lines of dialogue in a conversational context. Hence, we extracted instances of *want* utterances from the CHILDES database (MacWhinney, 2000), a growing collection of over 230 corpora of natural conversations with children in a number of languages, environments, situations, and with a variety of interlocutors. To obtain a diverse set of transcripts of *want,* we sampled 625 utterances in CHILDES containing an instance of *want* or *wanna* (another token for *want;* see Boas, 2004) as produced by English-speaking children using the R package **childesr** (Braginsky et al., 2020, version 0.1.2), via its function **get_tokens()**. By default, the function samples a single utterance, and so we adapted it to collect the surrounding context, i.e., the 7 lines before and after a child-produced *want* utterance. We used these dialogues to code for specific properties of the utterance that the child expressed. Consider the following example output produced by the modified **childesr** function:

-7	SI1	ready
-6	CHI	yyy go up
-5	SI1	no William ya don't go up the slide
-4	SI1	William
-3	CHI	what
-2	SI1	we don't go up the slide we go down the slide
-1	SI1	okay
00	**CHI**	**wanna jump**
+ 1	SI1	good job
+ 2	CHI	wanna jump
+ 3	SI1	ya jump off the slide good jump
+ 4	SI1	ready
+ 5	CHI	wanna jump
+ 6	CHI	yyy wanna jump
+ 7	SI1	ready

The numbers mark each conversational turn relative to the coded utterance (highlighted in bold). The labels SI1 and CHI refer to speakers in the conversation: SI1 is a label given by the original researchers who recorded the conversation; this paper's authors do not know their identity; CHI is used in every transcript across CHILDES to identify the child of study whose age and other features were recorded by the original researchers. Unintelligible speech is marked by "xxx" or "yyy", as in lines − 6 and + 6.

There are two main reasons to extract conversational contexts from the database. First, (at the time the transcripts were culled), the level of transcription in the R-accessible version of CHILDES was coarse-grained: it lacked markers such as punctuation or pauses in conversation, both of which can disambiguate utterances. For instance, a question mark or period in line 00 of the given example could easily disambiguate the clause type of the child's utterance. Or, pauses in an utterance, such as, "I want [pause] open the door" can mark that a child rephrased a desire as a simple, grammatical command; absence of a pause renders the utterance unambiguously ungrammatical. Second, the nature of child speech necessitates a large context size: many conversational turns in child conversation are single words, repetitions, nonsense syllables, or off-topic. Thus a generous context size helped us to code along many dimensions of

want utterances. It was not a perfect solution, however: we deemed 123 of the 625 gathered instances of child-produced *want*s un-informative because they either consisted simply of the word *want*, seemed interrupted, e.g., "I want you hey", or else contained unintelligible speech, e.g., "I want some yyy". We coded the remaining 502 instances along the rubric described below. Analysis scripts and data are available through the Open Science Framework: https://osf.io/hy2br/.

2.1. Coding methodology and rubric

Each informative instance of *want* was coded based on the child's year of age, which gave us 19 uses of *want* produced by children less than 24 months; 239 uses by children between 24 and 35 months (2-year-olds); 120 uses by children between 36 and 47 months (3-year-olds); 95 uses by children between 48 and 59 months (4-year-olds); and 29 uses by those 60 months or older. We thus dropped data from children outside the ages of 2–4, leaving us with 454 instances of child-produced *want* utterances.

We developed a novel coding rubric designed to make it transparent to analyze what children speak of when they use desire language, namely along the following three semantic categories: the subject of *want* (matrix subject); the subject of *want's* complement (complement subject); and the semantics of the child's desire, e.g., whether the child desired an object or an action to be performed. In addition to these semantic analyses, we coded for ancillary structural, syntactic properties of each utterance, i.e., for whether the utterance was grammatical or not; for whether the child asked a question; and for whether *want* was negated; we review the primary three coding categories below, and describe coding and analyses of ancillary properties in Appendix A:

1. *The matrix subject.* Utterances describing desires can concern the desires of the speaker (as in, e.g., "I want to go home"), or else desires of another individual (e.g., "Jack wants to go home.") We tracked the individuals whose desires children talk about, namely whether the child was talking about: a) the child ("I", i.e., first person singular); b) the child and at least one other person ("we", i.e., first person plural); c) another person in the conversation (second person); d) a real person outside the conversation (third person); e) a fictitious character, such as when the child voices a toy in play; or f) unclear, when there was more than one possible interpretation of who the subject was, or the utterance was too underspecified to discern.

2. *The subject of the embedded clause. Want* can be complemented with a clause (as in, e.g., "I want you to take Jack home") so we marked each utterance for the subject of the complement. Most labels were identical to those we used for the matrix subject: a) child, i.e., first person singular; b) we, i.e., first person plural; c) second person; d) third person; e) fictitious character; and f) unclear. We introduced two additional labels, namely: g) object, given when children talk about wanting something to be done to some object, e.g., "I want that dust bin away". We coded the balance of the utterances as h) NA, to indicate that they had no embedded clause; these cases included utterances in which *want* was complemented with a noun, as in "want a pretzel".

3. *The semantic type of the complement.* To understand what kinds of things children desire, we marked each complement either as a) an action, e.g., "I want to hear me singing"; b) a state/location, e.g., "yeah but maybe I don't want it in my purse anymore"; c) an object, when *want* was complemented by a nominal, i.e., it had no complement subject, e.g., "want a pretzel"; d) a person, used when the complement was a person's name, e.g., "I want Diane"; or e) unclear.

Both the authors coded the data along these constructs in a manner that was blind to the particular ages of the speaker of each utterance.

2.2. Inter-annotator reliability analysis

We assessed the reliability of the novel coding scheme described above. The first author of this paper reviewed the automatically collected data and eliminated 123 entries that were unsuitable for coding, for reasons such as overly sparse *want* utterances or contexts. This annotator and another (the second author of this paper) independently marked the first 100 suitable entries for all six coding categories. We calculated Cohen's kappa between the two sets of codes as a measure of inter-annotator reliability, and found high inter-annotator agreement scores for all coding categories, except for grammaticality (see Appendix A). This low score was the result of an earlier unclear definition, so the annotators refined the definition of the category (to the version given in Appendix A) and independently recoded the set of 100 instances of *want* for grammaticality. Table 1 provides inter-annotator agreement scores for all coded categories, following the revised definition of grammaticality. Both annotators then adjudicated each instance of disagreement for all

Table 1
Inter-annotator reliability scores, as measured by Cohen's kappa, for all coding categories.

Coding category	Cohen's kappa
Semantic	
Matrix subject	.76
Complement subject	.93
Complement type	.71
Syntactic	
Grammaticality	.71
Interrogativity	.77
Negation	.94

coding categories. The first author coded the rest of the utterances.

3. Results and discussion

We report patterns in children's usage of *want* based on each coding category. We analyze the frequencies of coded semantic patterns by subjecting them to Wilcoxon nonparametric tests (following recommendations by Lijffijt et al., 2016). And we report on developmental trends by subjecting the coded data to a series of Jonckheere-Terpstra nonparametric trend tests for independent samples (see, e.g., Hollander & Wolfe, 1973). These trend tests are appropriate for ascertaining a reliable stochastic trend over pre-defined ordered groups of samples, such as a test for whether behavior changes from ages 2 to 3 to 4. We used permutation analyses (B = 100,000 permutations) to estimate the p-values reported below. For each code, we tested systematic increases in the production of, e. g., grammatical sentences, from ages 2 to 3 to 4. A monotonic (increasing or decreasing) trend in the production of one of the coded categories (such as matrix subject) across these ages serves as evidence for incremental acquisition along that particular category, because it suggests gradual and age-indexed refinements to the coded category. Alternatively, a non-significant trend is consistent with at least three possibilities: the first is that the category is fixed at the ages analyzed such that the category does not develop during ages 2–4. The second is that the category shifts over time, but in an unpredictable way (e.g., such as if children produce 20% grammatical utterances at age 2, 100% grammatical utterances at age 3, then 50% grammatical utterances at age 4); the third is that the category reveals a qualitative and permanent shift (e.g., 20%, then 20%, then 100% grammatical from ages 2, 3, and 4, respectively). These latter two scenarios may occur in the absence of incremental acquisition, i.e., when a particular concept isn't refined gradually, but rather exhibits a discrete jump in development.

3.1. Matrix subject

Table 2 shows the proportion of different matrix subjects used in children's *want* utterances. Across the studied ages, children mostly talked about their own desires, i.e., their matrix subjects were in the first person singular. From ages 2–4, these self-referencing desires constituted 85% of their utterances, and far exceeded the next most produced matrix subject, i.e., second-person desires, which occurred in 8% of utterances (Wilcoxon test, $z = 16.9$, $p < .001$). The utterances revealed no reliable trend over time (Jonckheere-Terpstra trend test, $p = .61$), i.e., children described self-referencing desires at a stable rate over time. The result coheres with Bartsch and Wellman's (1995) and Ferres' (2003) findings that children predominantly produce self-referencing desires, but it conflicts with Pascual and colleagues' (2008) results. This discrepancy may result from the topics discussed or the conversational needs specific to Pascual and colleagues' transcriptions.

As we note above, the second most common matrix subject produced by children expressed second person desires. We tested a post-hoc hypothesis that second person matrix subjects occurred most often in the context of an interrogative utterance. As hypothesized, for all children aged 2–4, the use of interrogatives was primarily limited to when the second person, i.e. *you*, was the matrix subject of *want*, and so the two codes correlated significantly (Spearman rank correlation, $\rho = .91$). Together, the findings suggest a primary usage of *want*, i.e., to describe a desire experienced by the child, as well as a secondary usage of *want*, i.e., to ask whether a listener wants something. When children do report on the listener's desire, the utterance seems idiomatic and confirmatory (as in, e.g., "you got chocolate tea but it is whatever you want") or else in the form of a conditional (e.g., "if you wanna go to the art you have to pick a yellow ticket"); reports of what a person wanted tended to be limited to the other subject types. The results suggest further work on whether children genuinely understand how to talk about a second person's desires: it is unclear when children become competent in using the phrase "you want" in declaratives.

3.2. Complement subject

Table 3 shows the proportion of different complement subjects used in children's want utterances. Children produced complements with no subjects, i.e., non-clausal, nominal complements, in 44% of the utterances analyzed, and they produced complements whose subjects were themselves 41% of the time; these two most frequent patterns did not differ reliably from one another (Wilcoxon test, $z = .71$, $p = .51$), and they were both produced reliably more often than the third-most common response, i.e., second person complement subjects (7% of utterances; Wilcoxon tests, $zs > 10.33$, Bonferroni-corrected $ps < .003$). Fig. 1 shows the percentages of

Table 2

Total percentages of children's *want* utterances as a function of the matrix subject produced. In *italics*: the proportions of each subset of utterances produced as a function of age. For example, 8% of children produced a *want* clause whose matrix subject was second person; 2-year-olds produced 6% of those utterances; 3-year-olds produced 11% of those utterances, and so on.

Matrix subject	Example utterance	% of utterances…	… by age		
			2	**3**	**4**
child	"I want cup"	85%	*86%*	*83%*	*85%*
second person	"do you want medicine"	8%	*6%*	*11%*	*9%*
third person	"her wanna rock the baby"	3%	*3%*	*< 1%*	*5%*
fictitious character	"Superman want some oxygen"	2%	*3%*	*4%*	
unclear	"wanna go outside"	*< 1%*	*< 1%*	*< 1%*	
we	"we don't want the monsters"	*< 1%*	*< 1%*		

Table 3

Percentages of children's *want* utterances as a function of the complement subject. In *italics*: the percentages of each type of utterance produced as a function of age. For example, 44% of children produced a *want* sentence with a nominal complement. 2-year-olds produced nominal complements on 52% of *want* utterances; 3-year-olds did so on 43% of such utterances, and so on.

| Complement subject	Example utterance	% of utterances	...by age		
			2	3	4
nominal	"I want hankies"	44%	*52%*	*43%*	*25%*
child	"I want play with that"	41%	*36%*	*39%*	*56%*
second person	"Mommy you want ta try"	7%	*5%*	*11%*	*7%*
third person	"she doesn't wanna"	4%	*3%*	*4%*	*8%*
object	"I want it to be on a piece of paper"	1%	*2%*		*1%*
unclear	"wanna go outside"	1%	*< 1%*	*< 1%*	*2%*
fictitious character	"rabbit want to hold it"	1%	*< 1%*	*2%*	
we	"I want come on let's make a square"	< 1%		*< 1%*	
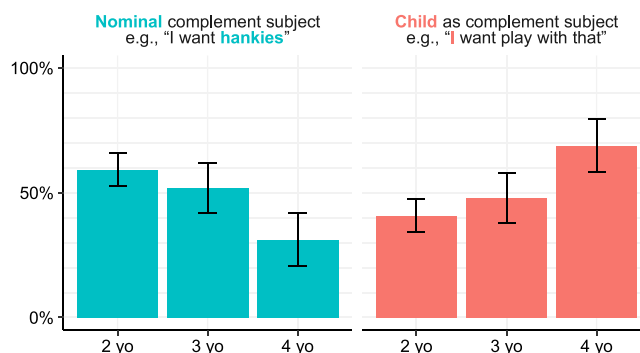
Fig. 1. Percentages of children's *want* utterances as a function of age, where the complement is nominal, i.e., non-clausal, and lacks a subject, or else the embedded subject is the child themself. Error bars reflect 95% confidence intervals.

these two primary responses as a function of age: children's utterances yielded reliably more self-referencing complements as they developed (Jonckheere-Terpstra trend test, $p = .003$) and they produced reliably fewer non-clausal complements as they developed (Jonckheere-Terpstra trend test, $p < .001$); and hence, the two patterns are negatively correlated (Spearman rank correlation, $\rho = -.74$). Together, these patterns show that as children grew older, they used the *want [nominal]* construction less and instead expressed desires saying *want [clause]*. These trends likely reflect online refinement in children's understanding of the semantics of *want*: a primitive notion of *want* is to express a desire for an object, perhaps an object that can be perceived but not reached (as in, e.g., "want bottle"). A more complex notion of desire is to desire some outcome that includes other agents and abstract relations. The data from children's production of complement subjects may reveal how the cognitive system incrementally acquires the semantics of *want*.

One way to assess how children's complement subjects shift over time is to test whether their complement subjects are the same as their matrix subjects. In general, children match complement subjects to matrix subjects reliably more often as they age (Jonckheere-Terpstra trend test, $p < .001$); but the effect is largely driven by the inclusion of non-clausal complements. When non-clausal complements are excluded from the trend analysis, the trend is no longer reliable (Jonckheere-Terpstra trend test, $p = .74$). In essence, children seem to match their complement subjects with their matrix subjects most of the time. What develops is their decreasing tendency to produce utterances of the form *want [nominal]*. As we show below, this same pattern has complementary ramifications on the trends in the production of complement types.

Table 4

Percentages of utterances in children's *want* utterances as a function of the complement subject produced. In *italics*: the proportions of each type of utterances produced as a function of age. For example, 38% of children produced a *want* sentence with a nominal complement. 2-year-olds produced nominal complements on 47% of *want* utterances; 3-year-olds did so on 33% of such utterances, and so on.

Complement type	Example utterance	% of utterances	...by age		
			2	3	4
action	"I wanna get my Easter bunny"	52%	*45%*	*57%*	*65%*
object	"I want a car"	38%	*47%*	*33%*	*21%*
state or location	"I want it to be on a piece of paper"	7%	*5%*	*8%*	*11%*
unclear	"no I don't want"	2%	*2%*	*< 1%*	*2%*
person	"I want my mummy"	1%	*1%*	*2%*	*1%*

3.3. Complement type

Table 4 provides an analysis of the different complement types in the utterances that children produced. The most frequent sort of complement in *want* utterances concerned actions, i.e., wanting to do something, wanting to have something, and so on. Children produced such utterances more often than the next most common desire they expressed, i.e., a desire for an object (52% vs. 38%; Wilcoxon test, $z = 3.3$, $p = .001$). And they produced both complement types more often (Wilcoxon tests, $zs > 9.75$, $ps < .001$) than relational desires that predicated some state or location, which occurred only 7% of the time. As children aged, they complemented *want* less with a nominal, i.e., an object complement type (Jonckheere-Terpstra trend test, $p < .001$), and more with a clause, i.e., an action complement type (Jonckheere-Terpstra trend test, $p < .001$; see Fig. 2). The result reinforces the pattern described in the previous section, i.e., with the complement subject.

Similarly, an analysis of complement type with the matrix subject shows that 2-year-olds expressed self-referencing desires for actions and objects, but as they grew older, they decreased in self-referencing desires for objects, i.e., *I want [nominal]* (Jonckheere-Terpstra trend test, $p < .001$) but increased in self-referencing desires for actions, i.e., *I want [action]* (Jonckheere-Terpstra trend test, $p < .001$), reinforcing the pattern illustrated in Fig. 1.

In sum, the corpus analysis we performed showed systematic development from ages 2–4 in the semantic production of *want*.

3.4. General discussion

The production of desire verbs such as *want* may reveal how children understand their own and others' mental states – but no prior analysis of desire language in the developing child (e.g., Bartsch & Wellman, 1995; Ferres, 2003; Pascual et al., 2008) had examined *what* children desire when they use desire verbs such as *want*. Children use desire language, e.g., the verb *want*, early in development, much earlier than verbs that describe the mental states of agents such as *think* and *believe* (for an integrative account of this phenomenon, see Harris, 1996). Systematic patterns in the way children discuss the objects of their desires can help illuminate how children conceive of others' mental states, i.e., theory of mind (Beaudoin et al., 2020; Sodian et al., 2020). For example, a child who spontaneously produces the following sentence: "Mom, you want me to clean my room tomorrow" has expressed a second-person desire – the child demonstrates capability in tracking her mother's mental state as separate from her own. Alternatively, desire language may reflect discrepancies between how children experience and how they communicate desire. As one reviewer observed, children may begin to communicate desires by linking certain sounds to different external contexts, and so their emotional comprehension of desire and their experience of desire may not follow the same trajectory. In either case, analyzing desire language may help reveal how children progress from a nascent mapping of words to contexts to a richer representation of how to communicate the experience of desire.

Previous analyses of desire language in children (e.g., Bartsch & Wellman, 1995; Ferres, 2003; Pascual et al., 2008) did not focus on objects of desires, and so they say little about how such language can reveal developing capacities for theory of mind. We developed a new coding scheme to examine how the production of *want* matures. The coding scheme depends not just on coding individual utterances, but on the examination of utterances in their conversational context, and so it is designed to investigate a wider range of questions about children's expressions of desire and their maturing cognitive abilities in general. We applied the scheme to 450 + instances of *want* – the most common and earliest emerging desire verb – produced by children in the CHILDES database aged 2–4. The analysis revealed two primary patterns of development in the way children refine their semantics of desire.

An early conception of *want* concerns the objects that children desire, as in *[I] want [nominal]*. It may be that these expressions are tantamount to commands, i.e., equivalent to *give me [nominal]*. But as children develop, they generalize their usage of *want* to predicate over not just objects, but actions and relations, as in, "I want play with this" (sic) or "I want do painting" (sic). The examples are revealing, because they too can be construed as commands equivalent to:
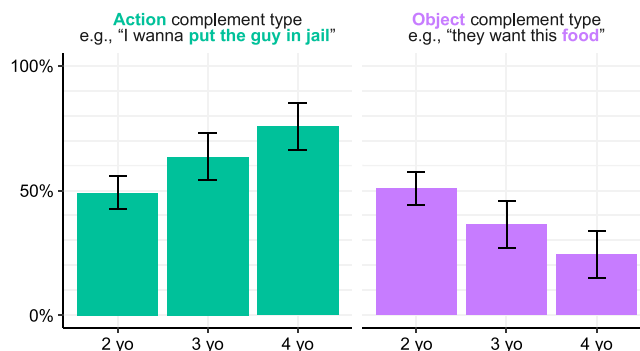
Give me this (so I can play with it).

Fig. 2. Percentages of children's *want* utterances as a function of age, where the semantic type of the complement is either an action or an object, i. e., is a non-clausal, nominal complement. Error bars reflect 95% confidence intervals.

Give me what I need (to paint).

But they show subtle refinement in the semantics of *want*, such that the desire verb can be complemented by other verbs (e.g., *play, do*) and not just objects or demonstratives (e.g., *paintbrush, this*). Children likewise gradually use *want* to describe desires about relations or states to manifest, e.g., "want it louder" and "want ta zipper open" (sic). This pattern manifests in the complement subject and semantic type of the complement to *want*, and represents one primary discovery of this research.

If early desire language is tantamount to issuing commands, then more sophisticated desire language may come about from conversations with caretakers. That is, caretakers may use *want* to ask questions about a child's desires, and children may learn this usage for the purposes of asking about others' desires. Indeed, as our analysis shows, the usage of second person desires (e.g., *you want*) correlates almost perfectly ($\rho = .91$) with the production of an interrogative across ages 2–4. This may be because *you want* is idiomatic early in development, i.e., it is used for highly specific purposes of inquiring about some alternative action that is about to take place, rather than actual consideration of an interlocutor's desires. Our analysis did not reveal that children ask more *want* questions as they age; instead, their newfound faculties in describing desires as relating to actions and relations may help them refine their queries, just as it helps them refine their declarative utterances. For instance, one older child asked a parent: "hey you want to play a game Mom?" This question is not a command; rather, it reveals interest in a caretaker's desires. The example helps illustrate the secondary discovery of our analysis, namely that children use *want* to speak about their own desires most often (contra Pascual et al., 2008), and their language about the second person's desires is mostly in the form of questions.

Indeed, the trend analyses we report show that the shift from simple to more complex *want* complements and the shift from describing personal desires to the desires of others produces systematic monotonic increases, i.e., increases from ages 2 to 3 and from ages 3 to 4. These gradual shifts support the notion that children incrementally acquire their understanding of *want*, i.e., they produce the verb in a wider range of semantic and syntactic contexts.

The usage of *want* may index, or interact with, children's developing theory of mind. One of the most influential accounts of theory of mind suggests that comprehending one's own mentality does not come prior to the understanding of others' mental states (see Schlict, 2023, for a recent review). The results above may present a challenge to such frameworks: they show that children's capacities for describing their own desires increase even before they begin to talk of second-person desires. But the results are not decisive: usage of *want* may index, not the development of theory of mind, but rather the changing nature of the verbal input directed to children. It may be straightforward to design experimental tests of whether children are most sensitive to verbal contexts or their own developing semantics in their interpretation of *want*: one way to do so is to provide children with novel contexts in which individuals express desires and to probe what those desires imply about mental states. Likewise, future work should investigate what children are able to understand about other people's desires, such as whether young children can comprehend talk about a second person's desires in declarative sentences. It is possible that children's use and competency with reports on the second person's desires are acquired after they learn to ask questions about those desires.

We also evaluated children's use of *want* for the syntactic features of grammaticality and whether *want* appeared in negated contexts (see Appendix A). While children's utterances did not grow more grammatical with age, they described negated desires more as they developed, and the pattern resulted in a marginal trend. Given the known difficulties with representing and reasoning about negation (cf. Cameron-Faulkner et al., 2007; Khemlani et al., 2012; Horn, 2001; Orenes et al., 2014), we suspect that experimental work could further evaluate how negation complicates children's ability to reason and speak about desires.

Overall, these findings add clarity to children's cognitive development in reasoning about desires. At age 2, they primarily desire objects, but as they grow older, they express desires for these objects less and more for actions they will perform; they are more inquisitive about what others want; and they envision a wider range of desirable possibilities for themselves and others.

CRediT authorship contribution statement

Hillary Harner: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sangeet Khemlani:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Data Availability

The following link provides a database of utterances extracted from CHILDES, annotations of utterances, as well as statistical analyses: https://osf.io/hy2br/.

Appendix A

Results of Corpus Analysis for Grammaticality, Interrogativity, and Negation

The corpus analyses we report included additional annotation to code for the following three properties of each utterance:

- **Grammaticality.** As our data came from spontaneous conversation, we applied criteria that depended solely on the inflection of *want* and its subject. For *want* to be properly inflected, it needed to be of the form *want* + *to* + verb, or *want* + nominal, and when negated, to be preceded by *do* + *not*. This meant that utterances such as "wanna try" and "don't want it" were marked as grammatical, even though they lack subjects; whereas "want go" and "not want you talking" were marked ungrammatical because of improper inflection of *want*. If a subject were present in the *want* utterance, it had to be in subject case, e.g., "I want to go zoo"; subjects in other cases led to marking the utterance as ungrammatical, as with, e.g., "her wanna rock the baby". Since the coding was limited in focus to *want* and its subject's inflection, it permitted other ungrammaticalities in utterances marked as grammatical, e.g., "I wanna be a engineer man", which ungrammatically uses two articles in a row, and *a* instead of *an*. Every utterance in this category was coded as "yes", "no", or "unclear".
- **Interrogativity.** "Yes" if *want* was used in a question; "no" if not. Often, question words such as *what* helped to adjudicate the matter. If such words were absent, then the conversational context was used: questions are often answered, and so the dialogue following a prospective question can include an interlocutor's answer. If neither the utterance nor its context could determine whether the utterance was interrogative, we marked it as unclear.
- **Negation.** We marked *want* as negated if it was in the scope of a negative word, e.g., "I don't want that" or if its complement contained *c-commanding* negation, e.g., "I want but I want no one to do" (see Haegeman, 1995, for a discussion on c-commanding negation).

For brevity, we report the results of the syntactic analyses of children's *want* utterances together. On grammaticality: overall, children's utterances remained at a stable rate of grammaticality through early development (see Fig. A1, left panel); they did not produce reliably more grammatical utterances from ages 2 to 4 (Jonckheere-Terpstra trend test, $p = .15$). One reason that children's grammatical utterances did not increase significantly over time may have been because they used more advanced language as they grew older, and so they made themselves susceptible to more complicated mistakes. Another reason may have been because grammaticality was coded only for the inflection of want and case marking of its matrix subject, and not for other sorts of errors in syntax. On interrogativity: children used questions quite sparingly: only 7% of their utterances were questions. The slight increase from ages 2 to 4 (see Fig. A1, middle panel) was not reliable (Jonckheere-Terpstra trend test, $p = .12$), indicating that the children did not appear to ask more want questions during this period (though it is possible that they asked more questions about other topics). On negation: children appeared to negate their want utterances more often as they grew older (see Fig. A1, right panel), with 2- and 3-year-olds using it roughly the same amount of the time (13–15%), and 4-year-olds producing it more (23%); this increase was marginal (Jonckheere-Terpstra trend test, $p = .06$).
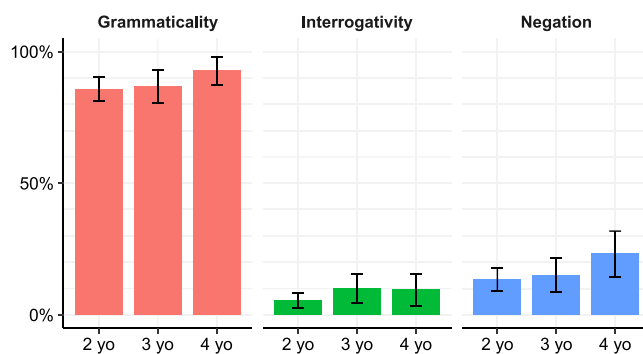

Fig. A1. Percentages of children's *want* utterances as coded for grammaticality, negation, and interrogativity as a function of age. Error bars indicate 95% confidence intervals.

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