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Revisiting the Epistemic Gap: Evidence for a Grammatical Source*

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Modals express two broad types of meanings: root meanings like abilities (1a), obligations (1b) or intentions (1c), and epistemic meanings like educated guesses (2a) or evidence-based inferences (2b).

- (1) a. *Olivia **can** speak Spanish.*
b. *Erin **has** to be home before 11pm.*
c. *I'm **going** to go to the shops before working.*
- (2) a. *Terence **might** speak French, since his mom does.*
b. *You **must** be going skating, since you're holding your hockey stick.*

Acquisition researchers have observed a period between approximately 2 to 3½ years when children use modal expressions with root meanings, but not with epistemic meanings (Stephany, 1979/1986; Wells, 1979; Shepherd, 1982; Papafragou 1998, i.a.). Why do epistemic meanings appear later in naturalistic production than root meanings? What explains this Epistemic Gap (EG)?

Three hypotheses have been proposed to account for this asymmetry. The conceptual hypothesis argues that the epistemic gap occurs because children at this stage are as yet incapable of the reasoning necessary to support epistemic meanings (e.g., Papafragou, 1998; Shatz & Wilcox, 1991). The frequency hypothesis holds that the epistemic gap occurs because children hear and consequently use significantly fewer epistemic modals than root modals. Finally, the grammatical hypothesis argues that the epistemic gap occurs because children lack the grammatical representations necessary to support epistemic modals (Heizmann, 2006; de Villiers, 2007).

In this paper, I present three new corpus studies which provide support for the grammatical hypothesis. The first study shows that usage frequency effects do not explain the epistemic gap, so we must look to an alternative explanation. The second study shows that young children are capable of what appears to be

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epistemic reasoning before age 3, contra the conceptual hypothesis, as evidenced by epistemic adverbs (*maybe, probably*; see also O'Neill & Atance, 2000). Finally, the third study provides positive support for a grammatical approach; children develop the ability to embed propositions just prior to first grammatically complex epistemic modals (like *must, have to*; c.f. simpler epistemic adverbs like *maybe* or *probably*). These findings are in line with current semantic approaches to modality wherein root modals scope over predicates and epistemic modals scope over propositions (Hacquard, 2006).

1. Background

1.1. The Conceptual Approach

It is standardly assumed that children younger than about 3 are as yet incapable of epistemic thoughts (e.g., Papafragou, 1998; Shatz & Wilcox, 1991) because they do not use epistemic modals. The evidence for this position comes from studies on the emergence of modal lexemes (e.g., *must, will, have*) in naturalistic longitudinal data. These studies have regularly found that root meanings (3a, b) arise before epistemic meanings (3c). First epistemic uses of the modal expressions examined occur consistently after 3, sometimes even later than 4, and always after first root uses (which usually occur soon after 2 years).

- (3) a. *Tree can't dance.* (Adam 2;08,16) **Root Ability**
b. *You must have pencil.* (Urging mother; Adam 2;11,28) **Root Deontic**
c. *He must be ready for his lunch.* (Baby crying; Adam 3;05,01) **Epistemic**

The accepted explanation is that children require more advanced Theory of Mind (ToM) to support epistemic meanings because epistemic modals require thinking about thinking (Papafragou, 1998). ToM refers to the ability to attribute inner states (thoughts, feelings, beliefs, etc.) to oneself as well as to others. The most robust milestone in ToM development is around age 4 when children begin to reliably pass False-Belief Tasks (Wimmer & Perner, 1983, i.a.) showing that they can attribute mental states to others that diverge from the states of the actual world, however, the above studies show that children begin using modal lexemes with likely epistemic meanings soon after age 3. De Villiers (2007) has argued that the direction of influence between grammatical development and conceptual development around age 3 remains unclear.

While it is likely that ToM and modal development are intertwined, the evidence for the conceptual approach rests overwhelmingly on a grammatically distinct subset of modal lexemes. Functional (or '*polysemous*'²) modals, are those modals that may express both root and epistemic meanings (see Perkins,

² This is shorthand; The same modal word (e.g., *must*) expresses both root and epistemic meanings in combination with different modal bases and order sources but the modal itself is not polysemous in the Kratzerian tradition, the lexeme is specified only for force (Kratzer, 1977, 1981).

1983; Sweetser, 1990, i.a.). For example, English *must* may express deontic (4a) or epistemic (4b) meanings.

- (4) *The baby must be fed...*
- | | |
|--------------------------------|---------------------|
| a. ...because he's hungry. | Root Deontic |
| b. ...because he's not hungry. | Epistemic |

On the other hand, lexical (or 'monosemous') modals are fully specified and express either a root meaning (e.g., *obliged to*, *able to*) or an epistemic meaning (e.g., *possibly*, *maybe*, *probable*, *think*, *know*), but not both. In other words, epistemic lexical modals are dedicated epistemic markers, while functional modals are not dedicated epistemic markers because they also express root meanings. Notably, epistemic adverbs like *maybe* and *probably* can stand alone (5B₁), or explicitly qualify a proposition (5B₂).

- (5) A: *Is the dog hungry?*
B₁: **Probably**
B₂: **Probably**, *since he hasn't eaten since breakfast*

The studies that are regularly cited as support for the conceptual approach primarily examine the emergence of the canonical modal auxiliaries like *must*, *can*, *could*, *will*, and quasi-modals like *have to*, *gonna*, *gotta* of English, all of which are functional modals. Some studies look at mood marking on the verb in other languages (Finnish, Greek, Turkish; Stephany 1979/1986), or modal verbs or auxiliaries in other languages (e.g., French, Bassano 1996; Mandarin, Guo, 1994). All of these studies have consistently shown that root meanings emerge several months (or more) before epistemic meanings. Likewise, all of these studies have examined semantically complex modal lexemes (or mood markers) which are not dedicated epistemic markers.

Studies that examine dedicated epistemic markers, like *maybe* or *probably*, provide informative evidence relevant to the epistemic gap as they abstract away from the independently difficult task of learning from polysemous input data (c.f. Rett and Hyams, 2014's approach to evidential development). Bassano (1996) notes early child usages of French *peut-être* ('maybe') at 2;6. More recently, O'Neill and Atance (2000)³ examined *maybe* and *probably* in naturalistic corpora from multiple children and found that children use these from as early as 2;01. These studies show that children may be able to use dedicated epistemic markers earlier than complex functional modals. However,

³ O'Neill and Atance's study also included the modal *might* along with *maybe* and *probably*, making a somewhat disjoint group. Unlike the adverbs *maybe* and *probably*, *might* occurs in a fixed position in the syntax (INFL; Pollock, 1989, i.a.) and cannot stand alone. *Might* does share one important property with lexical modals: it is uniformly epistemic in the input (see Wellwood and Hacquard, 2012 for evidence). It is unclear from their data groupings when exactly *might* occurs for each child.

more comprehensive and comparative study between lexical and functional modal development is necessary.

1.2. Revisiting the Epistemic Gap

In this paper, I argue that the best explanation for the Epistemic Gap is grammatical development. More specifically, epistemic meanings for functional modals like *must* are delayed relative to root meanings because epistemic meanings require more advanced grammatical abilities. Functional modals like *must* interact with tense and aspect whereby they scope below tense and aspect when they have root meanings and above tense and aspect when they have epistemic meanings (Hacquard, 2006, 2010 for arguments and discussion). In (6), the LF (Logical Form) interpretation of *must* is shown to be different relative to where in the structure the modal is interpreted; above the VP *must* is root, while above the TP *must* is epistemic. A paraphrase for (6a) is *The baby is obliged to be fed*, while for (6b), it is *It must be the case that the baby is fed*.

- (6) *The baby must be fed.*
 a. *The baby must_{Root} [be fed]_{VP}* **Root Deontic**
 b. *must_{Epistemic} [the baby be fed]_{TP}* **Epistemic**

Hacquard (2006) argues the above distinction arises because functional modal lexemes are anaphoric; they have an event variable (*e*) which must be locally bound at LF (c.f. Ramchand, 2012). In the low position, *must* is keyed to a root meaning because the modal's event variable is bound by Aspect in this position (7a). The modal is thus keyed to the verbal event. In the high position, *must* is epistemic because its event variable is bound by the speech act event (7b; see Percus, 2000). Epistemic modality is 'speaker-oriented modality' (e.g., Bybee & Pagliuca, 1985).

- (7) Event-binding for functional modals (Hacquard 2009)
 a. [CP λe_0 [TP **Asp₁ Mod e₁**[VP V e₁]]]
Alex must leave the building.
 b. [CP λe_0 **Mod e₀** [TP T **Asp₁** [VP V e₁]]]
Alex must've left the building.

From a learning perspective, the high epistemic position is more complex. The child must be able to scope linguistic materials above propositions, or conversely, she must be able to embed propositions. Further, it is not clear whether the child must acquire an understanding of the speech act as an event-binder, or whether this is a given. The root meanings of functional modals rest on less and simpler grammatical development, namely the child needs to be able to scope above the VP and use Aspect as an event-binder.

In sum, current semantic approaches to modals provide a complexity metric for functional modals: root interpretations require the ability to scope the

modal over a predicate, while epistemic interpretations require the ability to scope the modal over a proposition. Since evidence for the EG rests on functional modals, and the epistemic interpretation of these modals is grammatically more complex, it is perhaps not surprising that an asymmetry between root meanings and epistemic meanings exists.

In other words, the epistemic interpretation of *must* requires that the child can represent and bind grammatical material above a proposition. Is the epistemic gap better understood as pertaining only to functional modals? The Grammatical Hypothesis can be articulated as follows:

- (8) The Grammatical Hypothesis: The epistemic gap occurs for functional modals because young children lack the ability to embed propositions (i.e., sentential embedding, minimally of a TP).

If the grammatical hypothesis is correct, we would expect (a) the frequency hypothesis to not account for the observed EG, (b) epistemic lexical modals like *maybe* to be used prior to epistemic functional modals like *must*, and (c) the ability to embed propositional content to precede first epistemic uses of functional modals.

3. Study 1: Testing the Frequency Hypothesis

In this study I test the frequency hypothesis. Epistemic modals are less frequent in usage than root modalities, and arguably even less frequent in child-directed speech which may contain an elevated number of directives (=deontic utterances, e.g., *You shouldn't hit your brother*). However, no previous study, to my knowledge, has statistically assessed whether or not this epistemic gap is an effect of usage frequencies. To do so, we must determine the likelihood, given the low frequency of epistemic modals relative to root modals, that the child is in fact acquiring both meanings concurrently. We may observe an apparent epistemic gap simply because epistemic modals are rare relative to root modals.

3.1. Methods

This study centres on Sarah (Brown, 1973; MacWhinney, 2000). This corpus contains 139 files from 2;03 to 5;01 with a total of 37,021 child utterances. I used the *freq* command to extract a list of all lexical items used by the child in the corpus. I examined the *freq* output and noted all modal lexemes, both lexical and functional. Sarah uses the following modal lexemes in her corpus: *better, can, could, may, might, must, shall, should, will, would, got to, have to, need to, ought to, be going to, be supposed to, maybe*. All of the modal-marked utterances (n=1860) were then extracted with three lines of previous context and three of following. Modal usage as either root or epistemic was determined by manually reviewing each item. Where the *kwal*-extracted discourse context was not enough, the transcript was examined to look for

context-disambiguating information. Sarah's mother's speech was also randomly sampled for lexical and functional modals (n=300 items). These were coded as for Sarah's modals.

3.2. Results

Sarah's first root modals occur from the beginning of her corpus at 2;03 (9). She uses no epistemic modals, neither lexical nor functional, prior to 3;00, when she uses her first clear, spontaneous, epistemic with *must* (10).

(9) *CHI: **can**'t take down (Sarah, 2;03)

(10) *FAT: *find them?* [*them*=play dish set]

*CHI: *no.* [returns without the dishes]

*CHI: *where my dishes?*

*FAT: *I don't xxx*

*CHI: **must** *be gone* (Sarah, 3;00)

In order to test whether the epistemic gap is a usage frequency effect, I used the binomial test for concurrent acquisition (Snyder, 2007: Ch. 5). This test addresses the question of whether the acquisition of root and epistemic modals is concurrent (both are acquired at the same time, epistemic is just seems later because it is lower in frequency) or ordered (root before epistemic). A non-significant, null result would suggest that the apparent later emergence of epistemic meanings is due to chance, while a statistically significant result refutes the null hypothesis and would allow us to confidently search for a conceptual or grammatical explanations for the difference between root and epistemic modals.

Of Sarah's 1860 modal utterances, only 36 are probable epistemic uses (because they fully resemble adult uses of epistemic modals in terms of context appropriateness), and of those 25 are instances of *maybe*. Sarah uses 180 root modals before her 1st epistemic (10). At a steady state following her first epistemic use, from 37 months to 56 months, she uses 26 epistemic modals and 1372 root modals. The binomial test⁴ refutes the null hypothesis (p=0.03).

Of Sarah's mother's 300 modal utterances, 16 are epistemic. When the relative frequencies of Sarah's post-EG modals (36 epistemic, 1644 root) are compared to those of her mother using a χ^2 , the result is significant (X-squared = 20.6718, df = 1, p-value <0.001). Pearson residuals point to lower than expected epistemic modals for the child (p<0.001).

⁴ Binomial Test $p = (X / (X + Y))^Z$, where X corresponds to the number of times root modals are used in the twenty transcripts following the first clear epistemic use of a functional modal, Y stands for the number of times epistemic modals occur in the twenty transcripts following the first clear epistemic use of a functional modal, and Z stands for the number of root modals prior to the first clear epistemic use of a functional modal.

3.3. Discussion

This study has shown that epistemic modals are delayed beyond what is expected given usage frequencies. Further, after Sarah uses her first epistemic use of a functional modal (*must* at 3;0, demonstrating resolution of her individual EG), her epistemic modal uses remain lower than expected when compared to the input. These results provide evidence against the frequency hypothesis because epistemic meanings for both lexical and functional modals are delayed relative to root modals and remain lower than expected when compared directly to the input. The epistemic gap does not appear to be a frequency effect and so we must appeal to other sources of explanation.

4. Study 2: In search of epistemic lexical modals

While Sarah uses no epistemic lexical modals during her EG, previous literature suggests that other children do (O'Neill & Atance, 2000, i.a.). With this second study, the goal is to determine whether children are using epistemic lexical modals (*maybe, probably*) in adultlike contexts during their individual epistemic gaps (as defined as the period of time before the first epistemic usage of a functional modal). If so, children may not be conceptually limited – at least not categorically – from epistemic reasoning.

4.1. Methods

I examined 4 additional child corpora from the North American English section of CHILDES (MacWhinney, 2000), these were: Adam and Eve (Brown, 1973), Abe (Kuzcaj, 1977), and Naomi (Sachs, 1983). For each of the 4 corpora, I used the *freq* command from CLAN to extract a list of all lexical items used by the child in the corpus up until age 3;06 (when the epistemic gap was expected to be resolved). I examined the *freq* output and noted all modal lexemes used by the children, both lexical and functional. I grouped the modals according to their status as either lexical (11a) or functional (11b) modals. Note that both lexical modals used at this age are uniformly epistemic in the adult language, while the functional modals vary widely in interpretation but are predominantly root in usage, with the exception of *must* and *might* which are predominantly epistemic and exclusively epistemic, respectively (Hacquard & Wellwood, 2012; Tagliamonte & D'Arcy, 2007).

- (11) All modal expressions in the child corpora, until 3;06
- a. Lexical: *maybe, probably*
 - b. Functional: *can, could, may, might, must, should, will, would, got, have*

Each child's functional modals were exhaustively extracted and context-examined working chronologically until I could identify the first clear epistemic use of a functional modal. This usage determined the end of the individual

child's epistemic gap. Then, all instances of *maybe* and *probably* during the child's EG were extracted and context-examined to verify epistemic usage.

4.2. Results

The first clear epistemic uses of functional modals for each of the children are provided in (12). Eve did not use any functional epistemic modals, likely because her corpus, from 1;06 to 2;03, falls entirely within her Epistemic Gap stage. The other three children use their first epistemic functional modal all within a 3 month timeframe between 3;01 and 3;04, in line with previous literature on the subject and with Sarah's data in Study 1 above (*must* at 3;00).

- (12) First spontaneous epistemic uses of a functional modal
- a. *CHI: you **might** get sick when you eat peelings (Abe, 3;01)
 - b. *URS: I'm upstairs.
*CHI: you **might** fall down on me (.) Ursula. (Adam, 3;01)
 - c. *CHI: it's standing on the edge
*CHI: it **might** fell down if he stand on the edge (Naomi, 3;04)

The search of the utterances within the EG stage yielded between 2 and 3 epistemic adverbs per child, for a total of 9 epistemic adverbs. Among the epistemic adverbs, 6 were instances of *maybe*, and 3 were *probably*. All but one of these uses (16a) qualifies a proposition about a physical event. Given their small number, I provide all of the uses of *maybe* and *probably* below (13-16).

- (13) Eve's lexical modals during her EG
- a. *CHI: that outside.
*MOT: I don't hear anything. What is it?
*CHI: **probably** Cathy. (Eve, 2;01)
 - b. *CHI: I can't see it.
*MOT: no. too far away to see.
*CHI: when we go to his home (.) we **maybe** see it. (Eve, 2;02)
- (14) Adam's lexical modals during his EG
- a. *CHI: where go? [=a pen]
*CHI: **probably** in (th)ere (Adam, 2;06)
 - b. *CHI: where envelopes (.) huh?
*MOT: you one envelope's on the floor (.) by Ursula's foot.
*CHI: what dat [: that]?
*CHI: **maybe** fall? (Adam, 2;09)
 - c. *CHI: fix it.
*CHI: **maybe** does fit.
*CHI: let's fix. Mommy. (Adam, 2;11)

- (15) Naomi's lexical modals during her EG
- a. *CHI: who's crying?
*CHI: **maybe** it's Kimberly (Naomi, 2;06)
 - b. *FAT: I'm looking for my shoes (.) that's why I can't leave yet
*MOT: do you know where Daddy's shoes are?
*CHI: no. **maybe** they're in the bathroom (Naomi, 2;11)

- (16) Abe's lexical modals during his EG⁵
- a. *CHI: uhhuh I wan(t) (t)a taste one (.) Mom (.) I would **probably** like
some cheese+balls (Abe, 2;09)
 - b. *CHI: **maybe** these fit in here nope they don't fit in here .
(Abe, 2;10)

All of these uses are adultlike in terms of appropriate contexts (abstracting away from some grammatical errors like uninflected *fall* in (14b)). For example, in (13a) Eve's attention is drawn to a noise outside, which her mother doesn't hear. When her mother asks what it is, Eve makes a guess that Cathy is making the noise, and she qualifies this guess with *probably*. In (13b), Eve's use of *maybe* involves viewpoint and a conditional. She uses the negated root modal *can't*, stating that she cannot see something, and her mother concurs, adding that it is too far away. Eve then reasons that a change of viewpoint (*when we go to his home*) will change the circumstances and, *we maybe see it*.

4.3. Discussion

Each of the four children studied spontaneously used epistemic lexical modals *maybe* and *probably* in contexts that are compatible with epistemic reasoning. These occur at low frequencies but a qualitative analysis of each use shows that the contexts are adultlike. Of the 9 uses, only 1 refers to an inner state, and this inner state is that of the speaker. The others mostly qualify propositions about spatial locations or relationships. These uses are infrequent, so Sarah's lack of lexical modals during her EG (as seen in Study 1) is quite possibly a sampling effect.

The above utterances appear to involve epistemic reasoning. However, it is difficult to assess how adultlike these uses actually are from corpus data because it is hard to be wrong when one uses the word *maybe* (Papafragou, p.c.). The

⁵ Abe also uses the following modal utterance at 2;07 perhaps modelled after his mother's earlier use of *could*. This use may be epistemic, but it is somewhat unclear what Abe is trying to express so I didn't include it.

- (1) *MOT: I heard a bird that sounded like a bat it flew by the window.
*CHI: a mother bird feeding a baby worm for her baby bird?
*MOT: it **could**'ve been a mother bird getting a worm to feed her baby bird
*CHI: **must** be a big worm feeding a baby worm Mom (Abe, 2;07)

children may simply be signalling some component of epistemic reasoning, like that they are not making a full assertion, for example. However, there is still a difference between epistemic lexical modals and epistemic uses of functional modals; no child uses the latter before 3;00 while most children use the former.

Of the four children who used an epistemic functional modal (including Sarah from Study 1, but excluding Eve), the age of usage is not surprising, but the lexeme warrants discussion. The first clear use contained *might* in three cases (Adam, Naomi, Abe) and *must* in the fourth (Sarah). It is possible that children understand epistemic *might* earlier than other epistemic uses of functional modals (e.g., *could*, *must*) because of its lack of variation between root and epistemic meanings. This makes it a dedicated epistemic marker, albeit one that in all other respects patterns with the functional modals.

5. Study 3: Testing the Grammatical Hypothesis

For functional modals, broad differences between epistemic modality (above TP) and root modality (above VP) in terms of LF scope are expected to interplay with the overt syntactic development of sentential embedding. When the child produces only simple clauses we can expect no epistemic functional modals because functional modals are interpreted as epistemic only when they scope over propositions (minimally TPs). Once we see evidence that the child can embed TPs, then we may infer that she can embed propositional content. In other words, a child who can embed sentences within sentences should be able to scope a functional modal like *must* above a proposition at LF.

I assume that markers of sentential embedding, such as infinitival-*to*, embedded subjects, and obligatorily embedding matrix verbs, are overt, measurable evidence for the semantic ability to embed propositions (represented by minimally TP in the syntax) (c.f., Diessel and Tomasello, 1999). Do children produce markers of sentential embedding soon before first epistemic uses of functional modals?

5.1. Methods

This study, like Study 1, examined Sarah's modal utterances in more depth. All of Sarah's modal utterances (n=1860) and her utterances with *want* followed by a VP or TP/CP complement (n=282) were examined for evidence of sentential complements: embedded subjects (17a), infinitival-*to* (17b), and obligatorily-embedding verbs (17c; c.f. Diessel and Tomasello 1999). Each of the developments in (17) provides evidence for an embedded TP.

- (17) a. *I want* [VP *dance*] vs. *I want* [TP **you** (to) *dance*]
b. *I want* [VP *dance*] vs. *I want* [TP **to** *dance*]
c. *I want* [VP *dance*] vs. *I think* [TP *I want* (to) *dance*]

My results were cross-referenced with results from Diessel (2004) who studied the development of complements across all utterances in Sarah's corpus (as well as those of other children). Diessel (2004) reports first uses of certain verbs, but not necessarily from Sarah. Our data together allow for a comprehensive report of Sarah's development.

5.2. Results

Sarah's first apparent embedded subjects occur at 2;10 and are somewhat ungrammatical (18a). However, they are soon followed by a clearer example with an at 2;11 (18b;Diessel, 2004). Around the same time Sarah begins to use infinitive-*to* on the second verb in utterances with two verbs (19) and infinitival-*to* occurs regularly (albeit optionally) thereafter (though see e.g., Dye, 2011 for discussion of sub-perceptual articulations of grammatical morphemes).

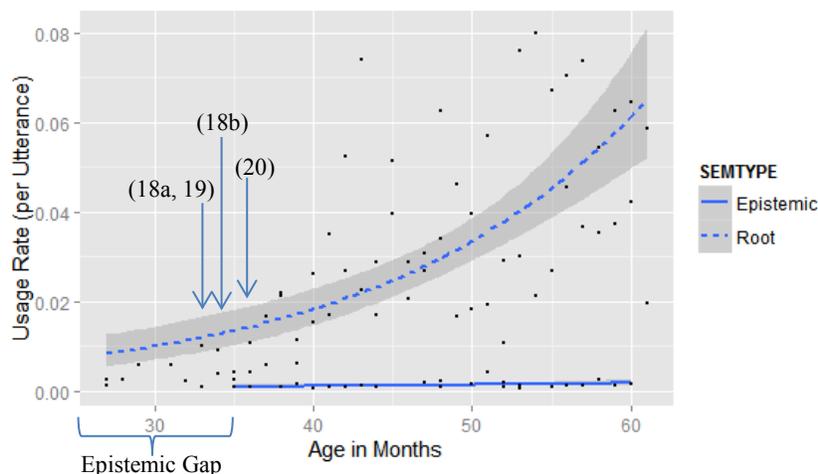
- (18) First subjects in embedded Spec,TP
- a. *I want **that** write on; I want **that** came out* (Sarah 2;10)
 - b. *Watch **me** do horsie* (Sarah 2;11)
- (19) First infinitival-*to* in embedded T_{INFINITIVE}
- I want to see him; I have to go my wee wee* (Sarah 2;10)

A few months later, and less than a month after her first epistemic use of a functional modal, Sarah begins to use obligatory embedding verbs like *think* (c.f. Diessel and Tomasello 1999, who argue that these early uses are parenthetical) which provide further evidence for multi-clause sentences. In (20) the mental state verb *think* (which is an epistemic lexical modal) qualifies the proposition *I'm go in there*.

- (20) First obligatory embedding verbs
- I **think** I'm go in there* (Sarah 3;01)

In Figure 1 I provide a graph of Sarah's modal development, divided between root meanings (the dashed line) and epistemic meanings (the solid line). We see that root meanings occur from the beginning of the corpus and steadily rise while epistemic meanings emerge at 3;00 (or 36 months) and remain low in frequency. Her epistemic gap is indicated, from 2;03 to 3;00. Her first occurrences of indicators of sentential (and thus, propositional) embedding are also indicated on the graph according to their example number, clustering before and concurrent with her first epistemic use of a functional modal.

Figure 1. Sarah's root and epistemic development



5.3. Discussion

Sarah's first epistemic use of a functional modal occurs at 3;00. This use follows indications that she has developed the ability to embed propositions. These findings are compatible with formal semantic approaches to functional modals (Hacquard, 2006). In addition, these results are generalizable as many previous studies have demonstrated that epistemic uses of functional modals appear consistently after 3, and others have demonstrated that first evidence of sentential embedding (if you allow that these are true instances of embedding) occur just prior to age 3 (e.g., Kirjavainen et al., 2009 for infinitival-*to*).

6. Discussion and Conclusion

In this paper, I have argued that the Epistemic Gap reported in the literature is best explained by grammatical development. The EG appears to only apply to functional modals like *must* or *have (to)*, unsurprisingly as this set of modals has received pride of place in the modality literature and previous L1A studies. The strongest conclusion is that children possess the ability to perform epistemic reasoning as early as 2 years. Dedicated epistemic markers, like the lexical modals *maybe* and *probably* do not need to be grammatically bound and thus allow children who are grammatically constrained to nonetheless express their epistemic thoughts. After sentential embedding develops, a functional modal like *must* can be bound in its epistemic position.

However, these strong claims must be tempered and further research is necessary to ascertain the semantic nature of early lexical modals like *maybe*. Whether early uses of *maybe* and *probably* are fully adultlike epistemic modals is impossible to ascertain satisfactorily from corpus data alone, especially for

syntactically flexible elements like adverbs which are easy to use and very difficult to use erroneously. Some indication that early uses may not be fully adult-like include the fact that there is a marked increase in explicit, clear mental state references after 3;06, both for mental state verbs (Shatz et al., 1983) and for *maybe*, *probably*, and *might* (O'Neill & Atance, 2000).

In conclusion, the Epistemic Gap applies only to functional modals, and grammatical development best explains the observed asymmetry between root uses of functional modals and epistemic uses of those same modals. The contributions of conceptual (ToM) development do not define the timespan of the epistemic gap for functional modals and appear unable to explain the lexical-functional developmental asymmetry seen for epistemic meanings.

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