

## Discovering Modal Polysemy: Lexical Aspect *might* Help

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### 1. Introduction

This paper investigates how children figure out that functional modal verbs like *moeten* 'must' in Dutch and *have to* in English (1) can be used to express both epistemic and 'root' (i.e., non epistemic) flavors: speakers can use (1) to mean that *John is required to exercise* (deontic necessity) or that *he likely exercises* (epistemic necessity). In this study, we focus on the input that children get.

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|-----|--|-----------|
| (1) | Jan <b>moet</b> wel sporten.                   | DUTCH     |
|     | Jan must PRT exercise                          |           |
|     | i. 'Jan has to exercise (the doctor said so).' | root      |
|     | ii. 'Jan has to work out (he's so muscular).'  | epistemic |

Following a previous corpus study on child-directed speech in English (van Dooren et al. 2017, in progress), we compare new Dutch data (from the Groningen corpus, Wijnen & Verrips, 1998) to existing English data (from the Manchester corpus, Theakston et al., 2001). This way, we can explore how modality is expressed in speech to children cross-linguistically. We find that in Dutch child-directed speech, even more so than in English, functional modal use is heavily skewed towards root meanings. Yet, children eventually figure out the full range of flavors these modals can express.

The existing acquisition literature shows a lag in children's production of epistemic modals, with epistemic uses in corpus samples typically appearing around age 3, about a year after children start producing root flavors, i.e. (Kuczaj & Maratsos, 1975; Cournane, 2015a,b, a.o.; cf. Veselinović & Cournane, to appear). This so-called "epistemic gap" (Cournane, 2015a,b) seems to be tied to functional modals only as children do produce "lexical" epistemics during their second year (e.g. *maybe*, *probably*; Cournane, 2015a,b).

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How do children pick up on the epistemic flavor in functional modals?

As argued in van Dooren et al. (2017), modal flavor is likely not evident from the situational context alone. Firstly, modals express a number of abstract concepts that lack a clear correlate in the real world, and learners face the challenge of having to map particular modal words to these abstract concepts<sup>1</sup>. For such "hard words", including attitude verbs *think* and *know*, it has been proposed that learners may need to rely heavily on cues stemming from the linguistic context (Gleitman & Landau, 1985; Gleitman et al., 2005, a.o., see also Hacquard & Lidz, 2018).

Secondly, functional modals present the additional challenge of lacking a one-to-one correspondence between form and meaning, which guides typical word learning (Clark, 1987). The same modal can be used to express different modal meanings, and the same modal meaning can be expressed by different modal words. Moreover there is a lack of mutual exclusivity, as the various modal meanings that a modal can express are often compatible in the same situations. For example, in a situation where John is *required to* exercise, he *plausibly* does exercise. Possibly, figuring out one of a modal's meanings (e.g. deontic) in these ambiguous situations could prevent children from realizing the modal can also express the other meaning (e.g. epistemic) (Papafragou, 1998:387).

Given the combination of low frequency of functional epistemics in child-directed speech, and the putatively unhelpful nature of the context, van Dooren et al. (2017) propose that distributional differences between roots and epistemics could cue the learner into epistemic flavor. Specifically, they propose that children could be cued into learning epistemic flavor by attending to lexical (and grammatical) aspect in the complement of a modal (see also Cournane, 2015a; Cournane & Pérez-Lérroux, in review). This is because aspect tracks temporal orientation (TO, the time of the event in the complement of the modal relative to the evaluation time of the modal), and root (but not epistemic) meanings seem to be restricted to future orientation<sup>2</sup> (Condoravdi, 2002). This contrast is displayed in (2-4), where the perfect (3), triggering past TO, and the progressive (4), triggering present TO, only seem to express epistemic possibility.

(2) John **may** exercise.                      Future/Present TO                      root, epistemic

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<sup>1</sup> Note that this is a mapping problem, as there is much evidence suggesting that the relevant modal conceptual abilities of reasoning about possibilities, necessities, goals and beliefs are already in place from infancy (Gergely et al., 1995; Woodward, 1998; Onishi & Baillargeon, 2005; Southgate et al., 2007, among others).

<sup>2</sup> Van Dooren et al. link this restriction to a constraint proposed in the formal semantic literature, the Diversity Condition (DC) (Condoravdi, 2002). The DC requires that the proposition expressed by the modal's prejacent does not hold (or fails to hold) throughout the worlds of the Modal Base (MB), i.e., the set of worlds that the modal quantifies over (following Kratzer's (1981) modal analysis).

- |   |            |                  |
|---|------------|------------------|
| (3) John <b>may</b> have exercised <sup>3</sup> . | Past TO    | *root, epistemic |
| (4) John <b>may</b> be exercising.                | Present TO | *root, epistemic |

In the absence of an overt grammatical aspect, *lexical aspect* also constrains TO: bare eventives, as in (2), can be future- or present-oriented (giving rise to a habitual interpretation), but bare statives tend to be present-oriented (5).

- |                              |            |                 |
|------------------------------|------------|-----------------|
| (5) John <b>may</b> be home. | Present TO | *root/epistemic |
|------------------------------|------------|-----------------|

Hence, present or past temporal orientation could hint at epistemicity. If epistemic uses of functional modals in the input occur frequently with stative prejacent, this could help learners realize that these modals may express non-root, and thus epistemic, modality. A prerequisite for this proposal to work is that the TO constraint be clearly manifest in the input. This was found to hold in English (van Dooren et al., 2017): both grammatical and lexical aspect distinguishes epistemic and root flavors. The question we ask here is: are these aspectual cues present in Dutch input as well?

### 1.1. Lexical aspect as a cross-linguistic cue? A comparison with Dutch

Even though English and Dutch are languages that are typologically similar, there are a number of reasons to believe that a comparison of these languages will shed more light on the learning path for modal flavor. First, using a corpus study on written adult Dutch language, Mortelmans (2012) has shown that epistemic flavor is less frequently expressed by functional modals in Dutch than it is in English. If this is true for child-directed speech as well, children hear even fewer functional epistemics in Dutch than in English, which increases the difficulty of the learning problem for children learning Dutch. This may suggest that the role of linguistic cues in the acquisition process is even more critical than previously thought.

Moreover, the signal coming from lexical and grammatical aspect in Dutch polysemous modals might be weaker than in English modals for three specific reasons: First, Dutch modals are tensed (6), and as Picallo (1990) and Hacquard (2010), a.o., have shown epistemic modals in the simple past can have a past TO even though their complement does not contain a perfect. Sentence (6) can be paraphrased as 'given the knowledge I have now, Mary probably was in Paris *last night*'. Given that there are two ways to get a past oriented epistemic (the other one being a present tense modal with a perfect in its complement), we

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<sup>3</sup> Note that there are cases in which modals combined with a perfect can give rise to a non epistemic interpretation (i). These counterfactual cases have been analyzed as a 'future in the past' (Condoravdi, 2002) and as such, not a counterexample to the temporal orientation constraint. What counterfactuals show is that aspect tracks TO imperfectly; we will get to the relation between aspect and TO in section 4.

(i)	John <b>could</b> have left earlier, but he didn't.	future TO	root
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might expect Dutch modals to combine with a perfect in its complement less than in English (though note that English *have to* is tensed as well and shows the same behavior).

- (6) Marie **moest** gisteren dus wel in Parijs zijn.  
Marie must.PST yesterday then WEL in Paris be  
'Mary must have been in Paris yesterday.'

Second, the signal provided by lexical aspect might be less strong in Dutch than in English as there does not need to be an overt verb in the complement of modals in Dutch (10). In these cases, the aspectual information on whether the complement is future-oriented or not is absent. As the flavor of these modals is always root (Barbiers, 1995; van Dooren, 2017), can children still learn something from this type of sentence?

- (7) Marie **moet** naar huis.  
Marie must to house  
'Marie has to go home.'

Third, we might expect Dutch modals to combine with a progressive in their complement less frequently than in English, as the progressive is not necessary to encode ongoing events in non-modal sentences (8).

- (8) Jan fietst op dit moment naar huis.  
Jan bike.PRES at this moment to home  
'John is biking home at the moment.'

Finally, Dutch modals frequently occur with a number of different particles, some of which have been described as having modal semantics themselves (*vast* 'surely', *zeker* 'certainly', *wel* 'affirmative', among others). Specifically, the frequent co-occurrence of *wel* and epistemic modals as in (9) has been noted before (Hogeweg, 2009, Giannakidou & Mari, 2018). Could this particle be a further cue to epistemic flavor, either quantitatively (because it only or always occurs with an epistemic), or qualitatively (because of its meaning)? In this paper, we will provide data on these properties in child-directed speech and briefly discuss how they might help or hinder learning modal flavor.

- (9) Marie **zal** (wel) thuis zijn.  
Marie will WEL home be  
'Mary is probably home.'

## 1.2. Roadmap and main takeaways

We discuss the methods of our corpus study in the next section, and provide an overview of the lexical and functional modals used in Dutch and English child-

directed speech in section 3. Our results show that adults produce both lexical and functional roots and epistemics, but that there is an overall bias towards root meanings of functional modals, which is even more pronounced in Dutch. Section 3 furthermore shows that modals with grammatical aspectual markers in their complements are rare in Dutch; however, both in English (van Dooren et al., 2017) and in Dutch, root and epistemic modals differ in the lexical aspectual properties of their complements. Because of the overall skew towards root meanings, however, the exploitation of these cues may require children to use them in conjunction with other cues. We discuss further implications and conclude in section 4.

## 2. Methods

### 2.1 Corpus Coding

We examine Dutch child-directed and overheard speech for modal usage patterns using the Groningen Corpus (Wijnen & Verrips, 1998) on the CHILDES database (MacWhinney, 2000). The Groningen corpus contains longitudinal data (monthly intervals) from seven Dutch children (6 boys) between 1;05-3;07. All the recordings were obtained in an unstructured home setting, with the child interacting with caregivers and an investigator. The adult productions that we considered the child's input consisted of both child-directed speech and speech addressed to other adults within the child's hearing. All utterances containing modal words were extracted (40,486 of 263,111 total utterances (of which 181,003 adult)). This corpus was chosen because of its reasonable sample size and because the recordings fall within the period where children start using their first modal utterances (Cournane, 2015a,b; O'Neill & Atance, 2000).

Modals were coded for syntactic category (*lexical*: adverbs, adjectives, verbs, *functional*: auxiliaries, semi-auxiliaries), as shown in Table 1, and for semantic flavor (*root*, *epistemic*). The root category consisted of modals with ability, teleological, deontic, bouletic and future flavors. For the polysemous modals *moeten* 'must', *hoeven* 'need', *kunnen* 'can' and *zullen* 'will' we also coded complements for lexical aspect (*stative* or *eventive verbs*), grammatical aspect (*perfect*, *progressive*) and occurring particles (*wel*, *toch* and *'other'*). The tests used to determine stative or eventive lexical aspect came from Dowty (1979). The *stative* category of lexical aspect contained verbs such as *zijn* 'be', *weten* 'know' and *hebben* 'have' as well as perception verbs such as *horen* 'hear' and *zien* 'see'. All other predicate types were coded as *eventive*.

To decide what the intended flavor of the polysemous modals was, the coders (the first two authors, both native Dutch speakers) used the contextual information provided in the CHILDES transcripts to interpret the modal utterances. An interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters in modal flavor, presence of particles, and aspect. 500 modal sentences were double-coded, and the interrater reliability for the raters was found to be  $\kappa = 0.90$  for modal flavor,  $\kappa = 0.89$  for

particles,  $\kappa = 1.0$  for grammatical aspect and  $\kappa = 0.93$  for lexical aspect (all almost perfect agreement, Landis & Koch, 1977).

Table 1. Overview of Dutch modals (polysemous in **bold**)

FUNCTIONAL		<b>kunnen</b> 'can', <b>moeten</b> 'must', <i>mogen</i> 'may', <b>hoeven</b> 'need', <i>willen</i> 'want', <b>zullen</b> 'will'
LEXICAL	V	EPISTEMIC: <i>denken</i> 'think', <i>weten</i> 'know', <i>vinden</i> 'find', <i>lijken</i> 'seem'; ROOT: <i>hopen</i> 'hope', <i>verplichten</i> 'oblige'; FUTURE: <i>worden</i> 'become', <i>gaan</i> 'go'
	ADV/ ADJ	EPISTEMIC: <i>misschien</i> , 'maybe', <i>waarschijnlijk</i> 'probably'; ROOT: <i>hopelijk</i> 'hopefully'
	PRT	EPISTEMIC: <i>vast</i> , <i>zeker</i> 'surely', <i>weleens</i> 'sometimes', <i>straks</i> 'likely'

## 2.2 Data Analysis

We first calculated the percentage of modal occurrences by syntactic category (Table 2) and then concentrated on the polysemous functional modals ( $n = 16,410$ ). In determining the modal flavor of these verbs we excluded all utterances that were incomplete sentences ( $n = 757$ ) and utterances that were direct repetitions (of child or adult speech) made by the speaker ( $n = 470$ ) leaving 15,185 utterances for further analysis. Of these modal utterances, 5343 occurred without a modal complement. The remaining 9842 polysemous modals were modeled with a generalized linear mixed-effect model (lme4 package, Bates et al., 2015; R Studio Core Team, 2008) to investigate whether lexical aspect is a significant predictor of modal flavor, including different child corpora as a random factor (glmer, Flavor~LexicalAspect+(1|corpus), family=binominal).

## 3. Results

### 3.1 General Modal Input

The complete modal inventory available in the Dutch child's input is displayed in Table 2, compared against earlier results from a similar study on English (van Dooren et al., 2017). Similar to English, monosemous epistemic lexical modals (such as *denken* 'think' and *weten* 'know') make up about 5% of the total input.

Table 2: Aggregate raw counts of modal utterances in the input by flavor and syntactic category (lexical & functional), Dutch and English (ENG results (van Dooren et al., 2017), (% of total adult utterances))

	Lexical modality				Functional modality	
	epistemic	root	epi/root	future	epi/root	future <sup>4</sup>
DU	9,402 (5.2%)	582 (0.3%)	11 (0.01%)	11,237 (1,3%)	20,765 (11.5%)	463 (0.3%)
ENG	(4.6%)	(3.7%)	(0.7%)	-	(6%)	(6.7%)

### 3.2 Polysemous Functional Modals

The proportion of epistemic interpretations for the different polysemous functional modals is displayed in Table 3. We found an overwhelming preference for root flavored uses of the polysemous modal verbs, with epistemic flavors comprising only 1.55% of the child's input (in English this was 9.3%). An example of root usage of the verbs *kunnen* 'can', *moeten* 'must' and *zullen* 'will' are provided in example (10). Epistemic uses of the same three verbs are presented in example (11).

Table 3: Aggregate raw counts of epistemic functional modal utterances

	<i>kunnen</i> 'can'	<i>moeten</i> 'must'	<i>hoeven</i> 'need'	<i>zullen</i> 'will'	Total
n epi/n total (%)	95/5660 (1.68%)	36/7315 (0.49%)	0/310 (0%)	104/1863 (5.58%)	235/15185 (1.55%)

- (10) a. Een kip **kan** toch niet vlieg-en?  
a chicken can PRT not fly-INF  
'A chicken can't fly, can he?' (Mother, Abel 1;11)
- b. (ee)n schaaps.herder, die **moet** op de schaap-jes pass-en.  
a sheep.herder that must on the sheep-DIM watch-INF  
'A shepherd, he has to watch the sheeps.' (Mother, Daan 3;02)
- c. Ik **zal** eens even je neus af.vegen.  
I will PRT PRT your nose off.wipe-INF  
'I will wipe your nose.' (Mother, Abel 1;11)
- (11) a. [Guessing with child which things could all be inside a gift]  
**Kan** allemaal in een kadoo-tje zitt-en.  
can all in a gift-DIM sit-INF  
'(that) could all be inside a gift.' (Investigator, Iris 2;11)

<sup>4</sup> English future functional modals are *will* and *would*; the single Dutch one is *zouden* 'would', as *zullen* 'will' is polysemous between a future (ia) and an epistemic use (ib). In this paper, we include Dutch future *zullen* in the root category as its temporal properties are similar to root modals (ii).

- (i) Ik **zal** wel vaak 'ja' zeggen aan de telefoon. (ii) Hij **zal** het warm hebben gehad.  
I will PRT often 'yes' say at the phone he will it warm have had  
a. 'I will say 'yes' often when I'm on the phone.' 'He was probably warm.'  
b. 'I probably say 'yes' often when I'm on the phone.' \*future, epistemic

- b. [Going through a picture book with child, asking what each animal is]  
 Nou dat **moet** dan wel een kat zijn.  
 well that must then PRT a cat be.INF  
 ‘Well that must be a cat then.’ (Mother, Iris 2;08)
- c. [Peter has been practicing falling techniques in the bathtub]  
 Dat **zal** me een water.ballet gegeven hebb-en.  
 that will me a water.ballet given have-INF  
 ‘That must have resulted in a watery mess.’ (Investigator, Peter 2;03)

To test the hypothesis that the temporal orientation of the polysemous verb’s grammatical environment provides a distributional cue for the child to pick up epistemic meaning, we investigated the types of lexical and grammatical aspect in the complements of both epistemic and root flavored functional modals.

For grammatical aspect, we found surprisingly few instances of either a progressive (0 instances) or a perfect complement (12 instances). From the 12 instances of perfective aspect we found, 11 occurred in an epistemic context. This trend is in congruence with the findings of the English study; the overall occurrence, however, is in contrast with van Dooren et al.’s study (2017), which found that English roots occur with perfect/progressive 0.96% (n=167), epistemics 9.8% (n=171).

For lexical aspect, we found that the proportion of stative complements in root contexts (6.6%) was significantly smaller than the proportion of stative complements in epistemic contexts (64%). These results are displayed in Figure 1, again comparing the Dutch results with previous findings from the English study of van Dooren et al. (2017). A generalized mixed effects model confirmed that lexical aspect is a significant predictor of modal flavor in Dutch,  $\beta = 3.20$ ,  $z = 18.93$ ,  $p = < 0.0001$ . This is in line with findings from van Dooren et al. (2017), with an even more pronounced preponderance of eventive root complements.

As for particles that occur in the modals’ complements (Figure 2), we found that *wel* is proportionally more frequent with epistemic flavored modals (40.4%) than with root flavored modals (7.4%). In contrast, a confirmation seeking particle like *toch* occurs about equally often with root (1.8%) and epistemic (3.0%) flavors. In all other instances, the complement of the modal (root or epistemic) contained either no particle (57% of the time) or particles that we categorized as ‘other’ (32.8%), an extensive set including (among others) *dan* ‘then’, *eens* ‘once’, *even* ‘shortly’, *nou* ‘now’, *niet* ‘not’, *maar* ‘but’.



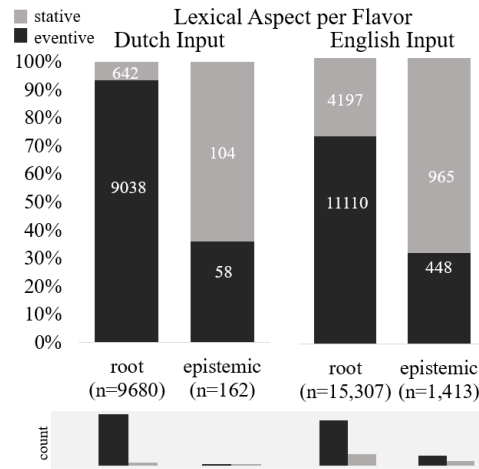


Figure 1. Proportion of eventive and stative complements per modal flavor + corresponding aggregate raw counts

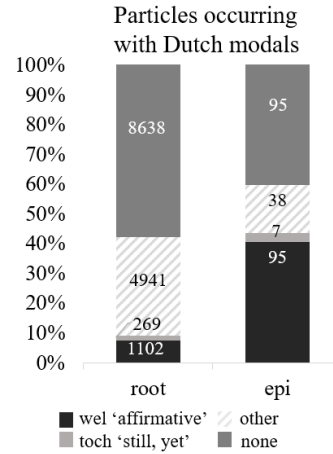


Figure 2. Distribution of particles in complements per flavor

#### 4. Discussion

We have shown that in both English and Dutch, the way adults use functional modals may obscure the polysemy: while adults produce epistemic lexical modals frequently, functional modals are strongly biased towards root uses. As such, it might initially be difficult for children to detect epistemic flavors, especially in Dutch as the percentage of epistemics compared to roots is even lower (confirming Mortelmans, 2012, who showed that in written language, Dutch epistemic *moeten* is used less than English epistemic *must*).

And yet, children eventually figure out modal polysemy. Van Dooren et al.'s (2017) hypothesis is that the linguistic context might help, and in particular, the temporal properties of modals encoded by aspect. The new results from Dutch partially replicate van Dooren et al.'s findings from English: Lexical aspect distinguishes root and epistemic polysemous modal verbs, as root usages mostly combine with eventives, while epistemic usages mostly combine with statives. The fact that this constraint holds across the two languages provides further support for the hypothesis that aspect might help children in discovering epistemic flavor.

##### 4.1. Zooming in on the differences between English and Dutch

In the introduction, we pointed out three syntactic and semantic differences between the English and Dutch modal system, which could influence the results. We discuss these properties here.

One major difference we found between English and Dutch is that epistemic

functional modals are used even less in Dutch than they are in English. One explanation that Mortelmans (2012) offers is that Dutch also frequently makes use of epistemic particles like *vast* 'surely' and *zeker* 'certainly' (12). Because there were so few instances of functional epistemics, it might not be surprising that we also found very few epistemics with a perfect or a progressive; further corpus research will need to show how often the epistemic particles as in (12) occur with a present or past temporal orientation.

- (12) De boer is **vast** aan het ploegen. (Father, Daan 2;07)  
 the farmer is surely at the plow.INF  
 'The farmer is likely to be plowing.'

A further suggestion we made specifically for the progressive is that this marker may not be necessary in Dutch to mark ongoing events. We did not find much evidence supporting this; most modals coded as epistemics with an eventive were not present-oriented (13). In fact, eventives embedded under an epistemic seem to only have present-orientation when the situation is a habitual, as in English (1).

- (13) (Context: talking about the electrician who will stop by)  
 hij **zal** zo wel komen. (Father, Josse 2;03)  
 he will soon WEL come  
 'He'll be here soon.'

For the perfect, we predicted that epistemics might occur less with this marker, as there is another way to express past TO in Dutch, namely, with the epistemic modal in the simple past. We again did not find much evidence for this hypothesis, as the past epistemics we found combined with a stative verb and did not have a past TO (15). However, this may again be due to the low number of functional epistemics we found; we found only 8 past unembedded ones. More data and more research are thus necessary to figure out this interaction between the past tense modal and aspect.

- (15) (Context: Child screaming about investigator eating the child's cookie)  
 nou, hij **kon** wel eens gelijk hebben. (Mother, Matthijs 3;02)  
 well, he can.PST WEL once right have  
 'well, he could be right.'

Finally, concerning lexical aspect, we expected a weakened signal as Dutch modals can occur without an overt verb. As such, the information giving evidence for the temporal orientation is not overtly present. Indeed, we found that Dutch modals appear without an overt verb 35% (n=5343) of the time, while English modals occur without 13% (n=2158) (consisting out of VP-ellipsis cases like *that could be*, *he might have*). The difference, as discussed in Section 1.3, is that Dutch root modals can occur with what seems overtly like a

PP (16a), an NP (16b) or an AP. Do these cases interfere with the signal that lexical aspect might give the child? As we will further discuss below, if children can make use of situational cues in combination with linguistic cues, we do not think these cases pose a problem. The context in these cases clearly signals to the child that the state of affairs in the complement of the modal does not already hold: In (19a), for instance, it is clear from the game that there is no puppet on it yet. What is more, the cases are highly consistent in their future orientation: Van Dooren (2017) shows that there are clear constraints on the interpretation of the modal complement when it does not contain an overt verb, one of these is that the complement is always eventive.

- (16) a. er    **moet** (ee)n poppetje op.                      b. **Moet** de aap        een luier?  
           there must a    puppet on                      must the monkey a    diaper  
           'There should be a puppet on.'  
           (Investigator, Peter 1;11)                      (Investigator, Josse 2;02)

Besides aspect, we looked at the occurrence of polysemous modals in combination with the particle *wel*: Even though epistemic modals occur often with *wel* (17), they don't always, and root modals occur with it too. What is more, *wel* also occurs outside of modal contexts, as a response to an explicit or implicit negative statement (Hogeweg, 2009). As a result, we think this would make it quite difficult for the child to use *wel* as a cue for epistemic flavor.

- (17) (Context: Child gives something to his mother)  
       (he)t **zal** wel    van    papa    z(ij)n schoenen gekomen zijn .  
       it    will WEL from daddy his    shoes    come    be  
       'It probably came from daddy's shoes.'                      (Mother, Peter 1;07)

#### 4.2. Discovering epistemic flavor: combining linguistic and situational cues

Returning to the main finding of this study, the difference in lexical aspect distribution between roots and epistemics holds both in Dutch and in English. We also found a number of root modals with a stative preadjacent, however, as in English (van Dooren et al., 2017). While the numbers are proportionally low relative to all root cases, they are overall rather frequent, given the large number of root modal uses. The raw counts of roots with a stative verb in their complement is, as a result, actually higher than the raw count of epistemics with a stative verb. Do these potential counterexamples render the constraint on temporal orientation not useful?

Van Dooren et al. (2017) noted that aspect is not a perfect way to track temporal orientation (see fn. 3), as other factors, including temporal adverbs, are at play. They used aspect as a proxy to track temporal orientation as temporal orientation is sometimes difficult to determine in context, while morphological aspectual cues are easy to observe. This difference in complexity might also be true for language learners. Here, we followed van Dooren et al.'s method. Many

of the roots with progressives, perfects, and stative complements we found are actually nonetheless future-oriented; one example is in (18), in which a root modal combines with the perfect. Here, the interpretation is counterfactual, which has been analyzed as a 'future in the past', i.e., a future orientation (Condoravdi, 2002).

- (18) You **could** *have said* hello. (Mother, Carl 2;04)

Another case of future-oriented statives is with *have NP* (19) or *be Adj/be NP* (20). In both cases, the interpretation seems to be coerced into an eventive meaning of 'get' or 'become' (linguistic evidence for an eventive meaning is that both can occur in the progressive). These cases make up a large part of root modals combining with statives in both English and Dutch (*have NP* ENG 55%, DU 45%, *be Adj/NP* ENG 31%, DU 30%).

- (19) a. Well they **can** *have* a tray each if they want. (Mother, Ruth 2;07)  
 b. Welk [/] welk boek **moet** je hebben ? (Investigator, Abel 2;11)  
 which which book must you have  
 'Which book do you want to have?'  
 (20) a. You **should** be careful getting down that way. (Mother, Liz 2;04)  
 b. jij **moet** (ee)n beetje stil zijn ! (Mother, Matthijs, 2;07)  
 you must a bit quiet be  
 'You have to be quiet!'

Van Dooren et al. (2017) propose for both counterfactuals and coerced readings<sup>5</sup>, the context might be particularly clear in that the state of affairs in the complement of the modal does not hold. After all, the child did not say *hello* in (18), and the child is not quiet in (20b). Perhaps, this makes the future-orientation more salient. In comparison, in cases of epistemics with stative prejacent the context does not make the truth or falsity of the state of affairs salient (21).

- (21) a. I think we **should** *be* nearly at Grandma's house now, do you?  
 (Mother, Ruth 2;11)  
 b. Dat **moet** wel heel lekkere chocolademelk zijn!  
 that must WEL very tasty chocolate.milk be  
 'That must be very tasty chocolate milk!' (Investigator, Abel 2;11)

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<sup>5</sup> In English, van Dooren et al. found quite a large class of genuine counterexamples to the temporal orientation generalization: the case of ability modals with perception verbs (i). In Dutch, this class is much smaller (ENG 12,9% of root modals occurred with a perception verb; in DU only 3%). We refer the interested reader to van Dooren et al. (2017, in progress) for an analysis on how the situation might help here too.

(i) I can hear a chugging noise what can it be (Mother, Anne 2;02)

In sum, we follow van Dooren et al.'s hypothesis that both in English and in Dutch aspectual cues help the learner bootstrap epistemic meanings for their modals, together with the context. But can learners actually make use of them? To be able to exploit these cues, learners need to be equipped with certain linguistic and pragmatic expectations and capacities: First, they should expect the restriction on temporal orientation in root modals. Second, by the time they learn modals, they should be able to make certain aspectual distinctions (for evidence that they do, see van Hout, 2016). Finally, they should be able to exploit situational and pragmatic cues in conjunction with the aspectual cues (for evidence that children are for instance sensitive to speakers' intentions, see metanalysis in de Villiers, 2007). Thus, if children can exploit them, aspectual cues provide a promising route towards discovering epistemic flavor usage.

A number of behavioral comprehension studies have been conducted to test children's sensitivity to aspectual properties of the prejacents when interpreting modals (Heizmann, 2006; Cournane, 2015a; Cournane & Pérez-Leroux, in review, a.o.). The exact role of aspectual properties in triggering epistemic readings is as of yet unclear from these studies, as they focus on older children (who already have epistemic interpretations in place) and comprehension preferences in various contexts. As such, the learning path sketched here functions as a proof of concept, showing that the ingredients for discovering epistemic flavor through aspect are available, at least in English and Dutch.

## 5. References

- Barbiers, Sjef (1995). *The Syntax of Interpretation*. Holland Academic Graphics
- Bates, Douglas, Martin Mächler, Ben Bolker & Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, 67(1). <https://doi.org/10.18637/jss.v067.i01>
- Clark, Eve (1987). The Principle of Contrast: A constraint on acquisition. In B. MacWhinney (ed.), *Proceedings of the 20th Annual Carnegie Symposium on Cognition*, 1-33. Erlbaum.
- Cournane, Ailís (2015a). Modal development: input-divergent L1 acquisition in the direction of diachronic reanalysis. PhD. Thesis, UToronto.
- Cournane, Ailís (2015b). Revisiting the Epistemic Gap: evidence for a grammatical source. *Proceedings of BUCLD39*. Cascadia Press.
- Cournane, Ailís & A.T. Pérez-Leroux (in review). Leaving obligations behind: Epistemic incrementation in preschool English.
- Condoravdi, Cleo (2002). Temporal interpretation of modals: Modals for the present and the past. In David Beaver, Luis Casillas Martinez, Brady Clark & Stefan Kaufmann (eds.) *The construction of meaning*, 59-88. CSLI.
- De Villiers, Jill (2007). The interface of language and theory of mind. *Lingua*, 117, 1858-1878.
- Dooren, Annemarie van (2017). 'Dutch must more structure', *Proceedings of the North-East Linguistic Society*, 165-175.
- Dooren, Annemarie van, Anouk Dieuleveut, Ailís Cournane & Valentine Hacquard (2017). Learning what *can* and *must* can and must mean. *Proceedings of the Amsterdam Colloquium*, 225-235.

- Dowty, David (1979). *Word meaning and Montague grammar*. Kluwer.
- Gergely, György, Zoltan Nadasdy, Gergely Csibra & Szilva Biro (1995). Taking the intentional stance at 12 months of age. *Cognition*, 56, 165–193.
- Giannakidou, Anastasia, & Alda Mari (2018). A unified analysis of the future as epistemic modality The view from Greek and Italian. *Natural Language and Linguistic Theory*, 36(1), 85-129.
- Gleitman, Lila, & Barbara Landau (1994). *Acquisition of the lexicon*. MIT Press.
- Gleitman, Lila, Kimberly Cassidy, Rebecca Nappa, Anna Papafragou & John C Trueswell. (2005). Hard words. *Language Learning and Development*, 1(1), 23–64.
- Hacquard, Valentine (2010). On the event relativity of modal auxiliaries. *Natural Language Semantics*, 18(1), 79–114.
- Hacquard, Valentine & Jeff Lidz (2018). Children's attitude problems: Bootstrapping verb meaning from syntax and pragmatics. *Mind and Language*, 1-24.
- Heizmann, Tanja (2006). Acquisition of deontic and epistemic readings of must and müssen. In T. Heizmann (ed.) *UMass Occasional Papers in Linguistics 34: Current issues in LA*. GLSA.
- Hogeweg, Lotte (2009). The meaning and interpretation of the Dutch particle *wel*. *Journal of Pragmatics*, 41, 519–539
- Hout, Angeliek van (2016). Lexical and Grammatical Aspect. In Jeff Lidz, William Snyder, & Joe Pater (eds.), *The Oxford Handbook of Developmental Linguistics*. OUP.
- Kratzer, Angelika (1981). The notional category of modality. In Hans Eikmeyer & Hannes Rieser (eds.), *Words, Worlds, and Contexts*, 38–74. De Gruyter.
- Kuczaj, Stan & Michael Maratsos. (1975). What children can say before they will. *Merrill-Palmer Quarterly of Behavior and Development*, 21, 89–111.
- Landis, J. Richard & Gary Koch (1977). The measurement of observer agreement for categorical data. *Biometrics* 33, 159-174.
- MacWhinney, Brian (2000). The CHILDES project: tools for analyzing talk. Erlbaum.
- Mortelmans, Tanja (2012). Epistemic must and its cognates in German and Dutch. The subtle differences. *Journal of Pragmatics*, 44, 2150--2164
- O'Neill, Daniela & Cristina Atance. (2000). “Maybe my daddy give me a big piano”: the development of children’s use of modals to express uncertainty. *First Language*, 20(58), 29–52.
- Onishi, Kristine & Rene Baillargeon (2005). Do 15-month-old infants understand false belief? *Science*, 308, 255–258.
- Papafragou, Anna (1998). The Acquisition of modality: implications for theories of semantic representations. *Mind and Language*, 13 (3), 370-399.
- Picallo, Carme (1990). Modal Verbs in Catalan. *NLLT*, 8, 285-312.
- R Development Core Team (2008). A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing.
- Theakston, Anna, Elena Lieven, Julian Pine, & Caroline Rowland (2001). The role of performance limitations in the acquisition of verb-argument structure: an alternative account. *Journal of Child Language*, 28, 127-152.
- Veselinovic, Dunja and Ailís Cournane (to appear). The grammatical source for missing epistemic meanings for modal verbs in child BCS. *Formal Approaches to Slavic Linguistics*. Michigan Slavic Publications.
- Wijnen, Frank & Maaïke Verrips (1998). The Acquisition of Dutch Syntax, In Steven Gillis & Annick de Houwer (eds.), *The Acquisition of Dutch*, 223-299. Benjamins.
- Woodward, Amanda (1998). Infants selectively encode the goal object of an actor's reach. *Cognition*, 69, 1–34.