Learning what *must* and *can* must and can mean*

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Abstract

This corpus study investigates how children figure out that functional modals like *must* can express various flavors of modality. We examine how modality is expressed in speech to and by children, and find that the way speakers use modals may obscure their polysemy. Yet, children eventually figure it out. Our results suggest that some do before age 3. We show that while root and epistemic flavors are not equally well-represented in the input, there are robust correlations between flavor and aspect, which learners could exploit to discover modal polysemy.

1 Introduction

Almost half of the world's languages have modal forms that express different "flavors" of modality [1]. For instance, English *must* can express both epistemic and deontic necessities, as well as various other "root" (i.e. non epistemic) flavors (e.g. teleological, bouletic): (1) can mean that John is required to eat meat (deontic necessity) or that he is probably a meat eater (epistemic necessity). We use the term "polysemy" atheoretically to refer to this behavior.

(1) John must eat meat.

In this paper, we ask when and how children figure out that modals like *must* are polysemous. To this end, we examine how modality is expressed in speech to and by children: how often it is expressed using *lexical* modals (verbs, adjectives or adverbs like *maybe*), which are typically monosemous, vs. *functional* modals (modal auxiliaries like *must*), which can be polysemous.

Picking up on the flavor polysemy of modals may be challenging for several reasons. First, learners may need to overcome word learning biases [2]: some modals (e.g. *must*) can express different meanings, violating the *principle of contrast*, and different modals can express the same meaning (e.g. *maybe* and *might*), violating the

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principle of mutual exclusivity. Second, modal flavor may not be obvious from the situational context alone: modals express abstract concepts with no reliable physical correlates to give away the intended flavor. Moreover, the context is often compatible with different flavors (if John *is allowed to* eat meat, he *plausibly* does), and even adults can't always tell the intended flavor [3].

Results from the existing acquisition literature suggest that children may not initially realize that functional modals can be epistemic: they do not produce functional epistemics until age 3, a year after they start producing root flavors ([5], [6], [7], [8], a.o.). This so-called 'epistemic gap' has been argued to reflect a conceptual lag ([9], [4]), or a grammatical lag ([8], [10]). However, children do produce "lexical" epistemics during the epistemic gap (e.g. *maybe*; [11]). This suggests that the epistemic lag is not primarily conceptual, since it is tied only to functional modals [8]. If children are not producing *functional* modals with epistemic flavors at first, have they perhaps not yet realized that these modals can express epistemic modality ([4]:387)? Does this gap arise from properties of the input?

To date, no study has extensively investigated the input, as the focus has been on children's productions. Here, we ask how adults use polysemous modals, and whether root and epistemic flavors are equally well-attested. We show that the way adults use functional modals may obscure their polysemy: epistemic modality is rarely expressed using functional modals. Furthermore, speakers tend to use polysemous modals in a monosemous way. Yet, children eventually figure out modal polysemy. We show that some may do so even before age 3. Given that modal flavor may not be evident from the situational context alone, and that the way speakers use polysemous modals obscures their polysemy, we ask whether cues to the polysemy of modals might come from their syntactic distribution.

We explore in particular correlations between modal flavor and modal syntax that have emerged from the literature on modality, notably in how modals interact with tense and aspect. We focus here on the fact that root and epistemic modals differ in *temporal orientation*: root modals tend to be future-oriented, epistemic modals tend not to be ([12], [13], [14], [15], a.o.). We show that while root and epistemic flavors are not equally well represented in the input, there are clear distributional differences that index these differences in temporal orientation. We sketch how children could exploit these distributional cues to figure out modal flavor, and in turn, modal polysemy.

2 Study

We examined the modal productions of 12 children and their mothers from the Manchester corpus [16], on the CHILDES database [17]. These child-mother dyads were recorded for one hour in play sessions, twice every three-week period, over the course of one year, from age 1;09 to age 3;00. All utterances containing modal words were extracted (81,854 of 564,625 total utterances). We chose this corpus for its density and uniformity of sampling sessions during the so-called epistemic gap period. This allows us to get a more accurate picture of rare early child uses of epistemics

than previous studies, and the uniformity across 12 dyads allows us to generalize observed patterns above and beyond individual differences.

Modals were coded for syntactic category (*functional*: auxiliaries, quasi-auxiliaries; *lexical*: adverbs, adjectives, verbs), as shown in (2), and for flavor (root, epistemic, metaphysical). Note that we do not differentiate amongst root flavors (e.g. ability, teleological, deontic), and leave the question of how children figure out root polysemy for future work. We also coded modal complements for aspect: grammatical (progressive, perfect), lexical (eventive, stative).

(2) Modal lemmas by syntactic category:
Functional Aux = can, could, may, must, should, might, shall, will, would
Quasi-Aux = have to, got to, ought to, supposed to, going to
Lexical V = *epis*: know, think, seem...; *root*: want, order... Adv = *epis:* maybe, probably... Adj = *epis*: sure, certain... *root*: able, capable...

2.1 Input: mothers' production

To get a sense of the kind of modals children are exposed to, we ask how frequently parents express epistemic vs. root modality, and how frequently modality is expressed using functional vs. lexical modals. The results for modal talk by category are summarized in Table 1. We find that for lexical modals, both epistemic and root modality are equally well attested in the input (4.6% of all mother utterances contain a lexical epistemic vs. 3.7% for lexical roots). Functional modals are well-represented in the input: 13% of all mother utterances. Thus, children hear a fair amount of epistemic modal talk, and a fair amount with functional modals. Whatever is responsible for the purported epistemic gap, it is not a lack of exposure to epistemic talk. Example input utterances are given in (3).

Table 1: Modal input per category (12 adults, % of total utterances)

Lexical modality			Functional modality	
epistemic	root	epis/root	epis/root	future
15,750 (4.6%)	12,433 (3.7%)	2,434 (0.7%)	20,528 (6%)	22,661 (6.7%)
30,617 (9%)			43,189 (12.7%)	

(3) Examples of modal utterances from the input
a. Lexical epistemic: Maybe$_{epi}$ there are no trousers. Mother (Ruth 2;00)
b. Functional epistemic: It might$_{epi}$ be cold in Scotland. Mother (Aran, 2;10)
c. Lexical poly: What do we need to draw first then? Mother (Aran, 2;03)

To investigate how well modal polysemy is represented in the input, we focused on functional modals that can express root or epistemic flavors (*can, could, may, must, should, have_to, got_to, supposed_to, ought_to* and *might*), and determined the intended flavor in context for six mothers[1]. Table 2 shows the distribution of root vs. epistemic flavors for each modal. We find that functional modals are overall used much more frequently to express root (92%) than epistemic (8%) modality. This effect is driven by the fact that the most frequent modals (*can, have to*) nearly always express root modality. Our results further show that modals that are in principle

[1] 10% of modals were double-coded, 99% overlap.

polysemous are mostly used monosemously: *can, could, have to, got to, should, supposed to* and *ought to* express root modality more than 90% of the time. *Must* and *may* are more often used with epistemic flavors. *Might* expresses epistemic possibility 65% of the time and metaphysical possibility 35% of the time.

Table 2: Polysemous modals by flavor (6 adults & children)

Modal	ADU Total	ADU Root	ADU Epi	ADU % root	CHI Total	*CHI* Root *(+repetition)*	*CHI* Epis *(+repetition)*	CHI % root
can[2]	5262	5230	32[3]	99%	2004	180 (+27)	1	100%
have to	1024	1020	4	100%	120	113 (+ 7)	0	100%
could	791	718	73	91%	54	39 (+ 11)	4	91%
might	592	205 (meta)	387	35%	66	19 (+ 25) (meta)	15 (+ 8)	46%
got to	522	519	3	99%	176	145 (+ 31)	0	100%
should	338	318	20	94%	18	9 (+ 9)	0	100%
must	199	40	159	20%	40	22 (+ 9)	6 (+ 3)	79%
supposed	111	102	9	92%	8	8	0	100%
ought to	12	12	0	100%	12	12	0	100%
may	12	4	8	33%	6	1 (+ 1)	4	20%
Total	8863	8167	696	92%	2592	547	51	91%

Thus, epistemic and root flavors are not equally well represented in the input, in ways that might make it challenging to see that functional modals can be polysemous[4]: such modals are in practice largely monosemous, and overall, used more frequently for root than epistemic modality. Do young children still pick up on modal polysemy? How well does their own production mirror that of their parents?

2.2 Children's modal production

We examined children's modals to see to what extent they reflect input. We see that children produce a fair amount of functional modals (3% of total utterances), though proportionally less so than their parents. They also produce some lexical epistemics (0.8% of total utterances), though proportionally less so than their parents, and less than they produce lexical root modals. These results are summarized in Table 3. Thus, while young children may be less disposed to express epistemic modality, they do produce some lexical epistemics well before age three.

Table 3: Modal output per category (12 children, % of total utterances)

Lexical modality			Functional modality	
epistemic	root	epis/root	epis/root	future
1,911(0.8%)	7,475 (3.3%)	1,003 (0.4%)	5,389 (2.4%)	2,305 (1%)
10,389 (4.6%)			7,694 (3.4%)	

[2] For child *can*, we used a random sample of 208 occurrences out of 2004 total occurrences.

[3] *Can* only has root interpretations in the adult grammar, except under negation. Half of the adults' epistemic *cans* were under negation. The other half were in questions, such as "Where can it be?". Such uses may be circumstantial (*possibility given the circumstances*) or epistemic (*possibility given the evidence*). In cases where it is difficult to tease apart epistemic from root modality, we erred on the side of epistemics.

[4] We hope to test this claim using computational modeling in the future.

We examined the functional modals produced by 6 children[5] (age 2;0-2;11), and find that children *do* produce epistemic modals, albeit much less frequently than roots (Table 2). The epistemic modals children produce are those that are most often used epistemically by adults (*might, must, may*). Yet, we see that flavor distribution for children's functional modals does not mirror that of their parents, particularly in the case of *must*, which is mostly used with epistemic flavors for adults (80%), but with root for children (79%), suggesting that they have a root bias, at least in production.

We further examined the first occurrences of various modals. For all children, *can* appears before other modals, in line with previous findings. Yet, children's first uses of *might*[6]*, could,* and *must* with an epistemic flavor occur before age 3, as does *maybe*. Furthermore, three out of the six children use *must* with *both* epistemic and root flavors before age 3 (5).

(5) a. Epistemic: it must be some of dolly's hair. (Aran, 2;09)
b. Root: I must get crane. (Aran, 2;02)

Our results show that children produce lexical and functional epistemics before age 3, suggesting that the epistemic gap from the literature may be due to the lower sampling density of previous studies. Further, at least some children use some polysemous modals with both root and epistemic flavors, suggesting they have worked out their polysemy.

2.3 Summary

Our corpus results show that the way speakers express modality might make it challenging to see that functional modals can be polysemous. Children, however, do pick up on modal polysemy, maybe even earlier than has been assumed in the literature. How do children figure it out? We hypothesize that children make use of distributional cues to hone in on the kinds of flavors their modals express. In this paper, we focus specifically on potential aspectual cues, building on insights from the semantic literature.

3 Aspectual cues to modal polysemy

How do children figure out that the same modal words can express different modal flavors? Paying attention to just the situational context may not settle the matter as possibilities do not have reliable physical correlates and the context is often compatible with different types of possibilities. Finally, the way speakers use modals does not provide ample opportunities to observe that the same modals express different flavors. Yet, young children work it out. We explore the possibility that to do so, children exploit temporal-aspectual cues that differentiate modal flavors.

[5] *Might*: 33% double-coded, 95% overlap. Other modals: 25% double-coded, 95% overlap.

[6] The first uses of *might* reported in previous literature appear with so-called 'physical predicates' [11] like *fall*, and are likely metaphysical. In our corpus, epistemic *might*, like metaphysical *might*, before age 3.

3.1 Modal flavors and Temporal Orientation

While context plays a big role in determining modal flavor [18], the availability of various modal flavors seems to be constrained by their interactions with tense and aspect ([19], [20], [21], [22], a.o.). In particular, many argue that root and epistemic modals differ in the kinds of ***temporal orientation (TO)*** they can have: root modals tend to be future-oriented (the time of the prejacent event has to follow the time at which the modal is evaluated), but epistemics tend not to be: they can have Past or Present TO ([12], [13], [23], [15], [14], a.o.).

TO arises from combinations of lexical and grammatical aspect in the modal's prejacent, as illustrated in (6). Progressive aspect results in present TO: in (6b) the possibility is about a concurrent run; Perfect aspect results in past TO: in (6c) the possibility is about a past run. In the absence of an overt grammatical aspectual, TO depends on the lexical aspect of the prejacent: eventives trigger future TO (6a) (or present TO with a habitual reading), statives lead to present TO (6d) (future TO is possible for instance with an adverbial like *later*). Root flavors are available only when a future TO is possible, i.e. in the absence of an aspectual operator in the prejacent (6a), and more easily with eventives than stative prejacents.

(6) a.	John may run.	Future TO, Present TO (habitual)	epis, root
b.	John may be running.	Present TO	epis, *root
c.	John may have run.	Past TO	epis, *root
d.	John may be home.	Present TO, %Future TO	epis, %root

These constraints, if well exemplified in the input, could provide useful cues to the learner: data like (6b) and (6c), with a progressive or perfect in the prejacent, which only allow non future TO, could hint that the modal expresses epistemic modality. Present-oriented stative prejacents might hint at epistemic flavors as well.

3.2 Aspectual cues in the input

Turning first to *grammatical aspect*, we expect epistemics, but not roots, to take complements with perfect and progressive aspects. This is what we find (Table 4): functional modals have embedded aspect 11% of the time when epistemic (7), but less than 1% of the time when root. All root modals with an embedded perfect had a counterfactual interpretation (8). Note that we do find a few cases of roots with embedded progressive, with *supposed to*, *should* and *got to* (9), which suggest that root modality is occasionally non future oriented.

Table 4: Grammatical aspect (6 adults)

	Epistemic (n=696) *(n% of total epistemics)*	Root (n=8167) *(n% of total roots)*
Progressive	14 (2.0%)	28 (0.3%)
Perfect	65 (9.3%)	40 (0.5%)
Total	79 (11.4%)	68 (0.8%)

(7) a. Because if it's got wet it might not be working properly (Mother, Aran 2;08)
b. Somebody *must have locked* the door to the post office (Mother, Aran 2;08)

(8) You *should have eaten* it at dinnertime. (Mother, Anne 2;03)
(9) You're not *supposed to be eating* the stethoscope. (Mother, Ruth 2;02)

As for *lexical aspect*, we expect epistemics to combine more readily with statives, and roots with eventives, if stative prejacents typically trigger present TO, and eventives future TO. We classified prejacents consisting of predicates that lacked an overt aspect using classic tests from [24]. Note that some predicates sometimes seem stative and sometimes eventive (perception verbs, *think*, and *have*). Because we did not want to commit to a particular view on how children interpret them, and the cues that these verbs provide may in fact be complex, we treated them all uniformly. The numbers reported in Table 5 show what the proportions are like when we treat them as eventives; the numbers in parentheses show the proportions if we were to treat them as statives.

Table 5: Lexical aspect (3 adults)

	Epistemic (n=316) *(n% of total epistemics)*	Root (n=4394) *(n% of total roots)*
+ stative	83% (91%)	6% (26%)
+ eventive	17% (9%)	94% (74%)

We see that stativity of the prejacent correlates with flavor: if we treat perception predicates as eventives, we see that roots take mostly eventives (94%) and epistemics take mostly statives (83%). If we treat them as statives, the link between stativity and epistemic modality is even more accentuated (91%). Further details with a breakdown per modal is provided at http://ling.umd.edu/~hacquard/project_modality.html

In sum, for functional modals, our corpus data show clear distributional differences between flavors, in terms of the aspectual properties of the modals' prejacents. These differences could provide useful cues to the learner that the modals can express different flavors. In the next section, we sketch how a syntactic bootstrapping account might work.

4 Bootstrapping modal polysemy from aspectual cues

According to the *syntactic bootstrapping hypothesis* ([25], [26], a.o.), children hone in on a word's meaning by exploiting principled links between its meaning and its syntactic distribution. This learning strategy may be critical for abstract meanings that lack clear physical correlates ([27], [28], [29], [30]). Modal meanings may be difficult to observe, aspect morphemes may be easier. If children expect modal flavors to correlate with temporal orientation, and different aspect combinations to trigger different TOs, they could exploit aspectual cues to work out modal flavor. In particular, non future TO may cue in the learner that a modal is epistemic. This bootstrapping account makes two crucial assumptions: 1) the link between TO and

flavor is principled; 2) children are able to pick up on and exploit aspectual cues. We turn briefly to each of these assumptions.

4.1 Motivating constraints on modal flavor and TO

The literature on modality argues that the link between modal flavor and TO is principled. Several authors propose that the link between root flavors and future TO is due to a general constraint which prevents vacuous uses of modals, e.g., Condoravdi's *Diversity Condition (DC)* [12], which requires that there are worlds in the modal base where the prejacent p is true and worlds where it is not.

(10) ***DC:*** For worlds w, times t, common ground cg, modal base MB, and property P, there is a w ∈ cg and w', w'' ∈ MB (w, t) such that (t, w', P) and ¬(t, w'', P).

Because epistemic and root modals differ in the kinds of facts relevant for their modal bases, the DC applies differently, in ways that interact with TO. Epistemic modals take an epistemic modal base, which picks out worlds compatible with a body of knowledge; root modals take a circumstantial modal base, which picks out worlds compatible with some circumstances[7].

Condoravdi first introduced the DC to explain why metaphysical modals (which [15][8] assume are a subset of *circumstantial*, i.e. root, modals) disallow non future TO. The past and the present are "settled", hence the same facts hold throughout metaphysically accessible worlds (or more generally, worlds compatible with the circumstances). This means that, when a root modal has present or past TO, the worlds of the modal base are uniform, and thus cannot differ with respect to whether p holds or not. The future, on the other hand, is not settled, hence the worlds of the modal base can differ w.r.t. p with future TO. The DC however allows epistemics with non future TO: an epistemic modal base picks out worlds compatible with a body of knowledge; what we know about the past or the present may leave some uncertainty about the truth of the prejacent p, hence the modal base can have both p and not p worlds.

The DC thus explains why root modals can only have future TO, but epistemics need not. Whether epistemics allow future TO is a matter of debate: some argue that epistemics disallow future TO because of the incompatibility of epistemicity with the uncertainty of the future [14]. If learners expect modal meanings to be governed by something like the DC, perhaps because of a more general expectation about non vacuity, they may be able to use TO to hone in on modal meanings.

4.2 Children's understanding of aspectual cues

Assuming that the links between aspectual properties and modal flavors are principled, can children make use of aspectual cues? Are they sensitive to aspectual distinctions, and do they exploit them when learning modals? Evidence from the acquisition literature suggests that they might. First, children seem to understand

[7] Modals also take an ordering source, which further constrains the set of worlds quantified over, and is responsible for meaning differences among root flavors.

[8] See also [38].

lexical aspectual distinctions very early in development ([33], [34]). Second, studies that have specifically examined modal flavor development in relation to complement type ([36], [37]) show that 3-year-olds may be sensitive to aspectual cues when interpreting modals.

5 Conclusions

The way speakers use modals makes it challenging to notice that some modals can express different flavors. Yet, children eventually pick up on this polysemy, and they may do so even earlier than the literature on the purported epistemic gap reports. We have proposed that one way children may pick up on modal flavor, and consequently modal polysemy, is by exploiting distributional properties that distinguish flavors. Speakers tend to use root modals with future TO, but not epistemic modals. If children expect correlations between modal flavor and TO, perhaps because they expect a constraint like the diversity condition to constrain modal meanings, they may exploit aspectual cues to discover modal meanings.

Modal polysemy seems to be, by and large, tied to functional modality. Might such syntactic bootstrapping overgenerate and trigger polysemous uses of monosemous, lexical modals? The constraints we have been discussing so far seem to be tied to notional modality, in ways that may transcend syntactic category: both functional and lexical modals with root meanings seem to be future-oriented, but not epistemic functional nor lexical modals [14]. Thus lexical modals that express root meanings perhaps rarely appear with non future TO, and won't lead learners astray. There may, however, be further constraints that uniquely apply to functional modality (e.g. scope interactions with tense, other modals, or quantifiers), which may require that learners be sensitive to the lexical status of their modals (see e.g., [37], [39]).

We have argued that a syntactic bootstrapping account where learners exploit aspectual properties to figure out modal meaning is plausible: the cues are clearly present in the input, the links between aspect and modal flavor are principled, and children seem to have the requisite understanding to exploit aspectual cues. We leave for future research whether children *do* in fact learn modal polysemy this way.

References

[1] van der Auwera, & Ammann (2011). Overlap between situational and epistemic modal marking. In Dryer & Haspelmath (eds.), *The WALS online,* 76. Max Planck Library.

[2] Clark (1987). The Principle of Contrast: A constraint on acquisition. In MacWhinney (ed.), *Proceedings of the 20th Carnegie Symposium on Cognition*, 1-33. Erlbaum.

[3] Coates (1988). The acquisition of the meanings of modality in children aged eight and twelve. *Journal of Child Language,* 15, 425-434.

[4] Papafragou (1998). The Acquisition of modality. *Mind and Language* 13 (3), 370-399.

[5] Kuczaj & Maratsos (1975). What children can say before they will. *Merrill-Palmer Quarterly of Behavior and Development* 21, 89–111.

[6] Wells (1979). Learning and using the auxiliary verb in English. In Lee (ed.), *Language Development,* 250-270. Croom Helm.
[7] Stephany (1979). Modality. In Fletcher & Garman (eds.) *Language Acquisition,* 375–400. CUP.
[8] Cournane (2015). Modal development. PhD. Thesis. UToronto.
[9] Sweetser (1990). From etymology to pragmatics. CUP.
[10] Veselinovic & Cournane (accepted). The grammatical source for missing epistemic meanings for modal verbs in child BCS. In *FASL 26.* Michigan Slavic Publications.
[11] O'Neill & Atance. (2000). The development of children's use of modals to express uncertainty. *First Language*, 20(58), 29–52.
[12] Condoravdi (2002). Temporal interpretation of modals. In Beaver, Casillas Martinez, Clark & Kaufmann (eds.) *The construction of meaning*, 59-88. CSLI.
[13] Werner (2006). Future and non-future modal sentences. *Natural Language Semantics,* 14, 235-255.
[14] Klecha (2016). Modality and embedded temporal operators. *Semantics and Pragmatics,* 9, 1-55.
[15] Rullmann & Matthewson. (in press). Towards A Theory of Modal-Temporal Interaction. To appear in *Language*.
[16] Theakston, Lieven, Pine, & Rowland (2001). The role of performance limitations in the acquisition of verb-argument structure. *Journal of Child Language*, 28, 127-152.
[17] MacWhinney (2000). The CHILDES project. Erlbaum.
[18] Kratzer (1981). The notional category of modality. In Eikmeyer & Rieser, (eds.), Words, Worlds, and Contexts, pages 38–74. De Gruyter.
[19] Cinque (1999). Adverbs and functional heads. OUP.
[20] Brennan (1993). Root and epistemic modal auxiliary verbs. Ph.D. Thesis. UMass Amherst.
[21] Stowell (2004). Tense and modals. In Guéron & Lecarme (eds.) The Syntax of Time, 495–537. MIT Press.
[22] Hacquard (2010). On the event relativity of modal auxiliaries. *Natural Language Semantics*, 18(1), 79-114.
[23] Kratzer (2012). Modals and conditionals: new and revised perspectives. OUP.
[24] Dowty (1979). Word meaning and Montague grammar. Kluwer.
[25] Gleitman (1990). The Structural Sources of Verb Meanings. *Language Acquisition,* 1, 3–55.
[26] Lidz (2006). Verb learning as a probe into children's grammars. In Hirsh-Pasek & Golinkoff (eds.) *When Action Meets Words*, 429-449. OUP.
[27] Gleitman, & Landau (1994). *Acquisition of the lexicon.* MIT Press.
[28] Gleitman, Cassidy, Nappa, Papafragou & Trueswell (2005). Hard words. *Language Learning and Development,* 1(1), 23–64.
[29] Papafragou, Cassidy & Gleitman (2007). When we think about thinking. *Cognition*, 105, 125–165.
[30] Hacquard & Lidz (to appear). Children's attitude problems. *Mind and Language.*
[33] Wagner (2001). Aspectual influences on early tense interpretation. *Journal of Child Language*, 28, 661–681.
[34] van Hout (2016). Lexical and Grammatical Aspect. In Lidz, Snyder, & Pater (eds.), *The Oxford Handbook of Developmental Linguistics.* OUP.
[36] Heizmann (2006). Acquisition of deontic and epistemic readings of must and müssen. In Heizmann (ed.) *UMass Occasional Papers in Linguistics 34*. GLSA.
[37] Hacquard (2013). On the grammatical category of modality. In Aloni, Franke & Roelofsen (eds.) *Proceedings of the 19th Amsterdam Colloquium,* 19–26.
[38] Thomas (2016). Circumstantial modality and the diversity condition. In Etxeberria, Fălăuş, Irurtzun, & Leferman (eds.), *Proceedings of Sinn und Bedeutung 18*, 433–450.
[39] Hacquard & Cournane (2016). Themes and variations in the expression of modality. *Proceedings of the 46th Annual Meeting of NELS*, 21-42.