This article was downloaded by: [University of Toronto Libraries] On: 27 January 2014, At: 11:58 Publisher: Routledge Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Language Acquisition

Publication details, including instructions for authors and subscription information: <u>http://www.tandfonline.com/loi/hlac20</u>

In Search of L1 Evidence for Diachronic Reanalysis: Mapping Modal Verbs

Ailís Cournane^a ^a University of Toronto Published online: 24 Jan 2014.

To cite this article: Ailís Cournane (2014) In Search of L1 Evidence for Diachronic Reanalysis: Mapping Modal Verbs, Language Acquisition, 21:1, 103-117, DOI: <u>10.1080/10489223.2013.855218</u>

To link to this article: <u>http://dx.doi.org/10.1080/10489223.2013.855218</u>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at http://www.tandfonline.com/page/terms-and-conditions



BRIEF ARTICLE

In Search of L1 Evidence for Diachronic Reanalysis: Mapping Modal Verbs

Ailís Cournane

University of Toronto

The lexical mapping of abstract functional words like modal verbs is an open problem in acquisition (e.g., Gleitman et al. 2005). In diachronic linguistics it has been proposed that learner mapping errors are responsible for innovations in the historical record (see Kiparsky 1974; Roberts & Roussou 2003, among others). This suggests that child error patterns should be consistent with historical changes. I studied the acquisition of modal lexemes by flavor (e.g., ability, epistemic) in order to assess the validity of this proposal in relation to the mapping problem. A preference task and a sentence-repair task were designed to address the question: Do children make structural mapping errors that, if left unchecked, are compatible with the innovations we see in the historical record (e.g., deontic > epistemic)? This study provides experimental data on the acquisition of modal lexemes by flavor and some long-awaited preliminary support for the hypothesis that child learners drive historical change.

1. INTRODUCTION

Modality is a semantically defined category that covers a variety of meanings, all of which qualify the main proposition with respect to its possibility or necessity (e.g., Palmer 1986). Modals divide into two broad categories: root and nonroot. Root modals cover dynamic meanings such as ability (1a), and means to achieve a goal (1b), as well as deontic meanings like permission and obligation (1c). Nonroot modality includes the future (1d) (widely believed to be modal, e.g., Enç 1996; Copley 2002; and known to occur later in diachrony than root modalities, Bybee, Perkins & Pagliuca 1994) and epistemics, which relate the available evidence to speaker knowledge (1e).

- (1) a. David can swim better than a fish. (Root: Ability)
 - b. You have to take the Parc bus to get to Mile End. (Root: Teleological)

Correspondence should be sent to Ailís Cournane, University of Toronto, Linguistics, Sidney Smith Hall, 4th floor, 100 St. George Street, Toronto, ON M5S 3G3, Canada. E-mail: ailis.cournane@gmail.com

- c. You can use my floss. You should floss more regularly. (Root: Deontic)
- d. *I'll get in trouble if they catch me!* (Nonroot: Futurity)
- e. *Beth must want to go dancing, she's wearing her dancing shoes.* (Nonroot: Epistemic)

How do children acquire the "flavors" of modal verbs like in (1)? Learning a modal lexeme represents a difficult mapping problem involving matching the lexeme to complex syntax and semantics. Modal lexemes typically map to multiple flavors, and in turn multiple lexemes may cover a single flavor. Furthermore, modals are not linked to the argument structure (salient input for bootstrapping verb meanings, e.g., Gleitman et al. 2005). When learning a modal a child must determine its: (a) syntactic category (e.g., lexical V, functional V, AUX), (b) quantificational force (existential or universal), and (c) flavor based on possible worlds semantics (e.g., ability, deontic, epistemic; see Kratzer 1977, 1981, 1991).¹

My goals for this study are first, to describe the lexical errors children make when choosing modals in given semantically defined contexts, and second, to experimentally evaluate a hypothesis from diachronic linguistics that suggests that child mapping errors lead to directional change in the historical record (e.g., Roberts & Roussou 2003; van Gelderen 2004).

Previous experimental studies on the acquisition of modal verbs have largely focused on quantificational force. Hirst & Weil (1982) tested the strength contrast between an existential modal (may), two universal modals (should, must), and the declarative (is) in deontic and epistemic contexts, assuming the strength hierarchy is > must > should > may. In the deontic context, the child was asked to direct a puppet based on contrasting statements from two teachers (*He* must go to the red room vs. He may go to the blue room); in the epistemic context, the child was asked to find a peanut based on contrasting sentences (*The peanut is under the cup* vs. *The peanut may be under the box*). Across both conditions the greater the difference in modal force, the earlier the contrast was understood. For example, is versus may is understood earlier than must versus should or is versus must. Byrnes & Duff (1989), Noveck, Ho & Sera (1996), and Bascelli & Barbieri (2002, for Italian learners) conducted variations of this experiment with much the same findings.

Longitudinal naturalistic studies have made the general observation that root modalities (e.g., ability, permission) precede epistemic modality (e.g., Kuczaj 1977; Wells 1985; Shatz & Wilcox 1991; Papafragou 1998). Early modals denote ability or desire (*bouletic* root modality): *can* and *want* (2a). These occur around 2;06 correlating with the development of basic desire-intentional psychology. Closer to the third birthday children begin using deontic-flavored modals like obligation *have* and permission *can* (2b). Finally, after age 3, children begin to use epistemic modals like *must* and *might* (2c). In general, root meanings precede epistemic.

- (2) a. Tree can't dance. (Adam 2;08,16)
 - b. You must have pencil. (Context: urging his mother to take a pencil, Adam 2;11,28)
 - c. He must be ready for his lunch. (Context: his baby brother is crying, Adam 3;05,01)

Papafragou (1998, 2001) has argued that the order of emergence of modals correlates with the child's emerging theory of mind (ToM). Children must develop the mental capacity to evaluate the content of their thoughts before they can compute epistemic modality. Heizmann (2006)

¹Flavor is composed of two parts: the *conversational background* and the *ordering source*.

tested whether syntactic development may also play a role (e.g., Villiers & Villiers 2000). She tested English *must* and German *müssen*, which have comparable semantics but are ambiguous in different syntactic frames. In Heizmann's experiment, the English sentence, *Who must be eating a banana*? is only felicitous with an epistemic reading, while *Who must eat a banana*? is only deontic. An equivalent contrast is not possible in German, which lacks the present-progressive; *Wer muss ne Banane essen*? ('Who must the banana to eat?'). In both languages the habitual is ambiguous (*He must go to the icebox every night*). Heizmann found that even the youngest, pre-ToM, children (age 3) understood the unambiguously epistemic sentences. With ambiguous syntax, there was an early preference for deontic readings over epistemic in both languages. Fond (2003) also found that 4-year-old children very slightly preferred deontic readings over epistemic readings of *must* in English and *deber* in Spanish despite an adult lexicalization of deontic meanings with *have* and *tener que* respectively.

No previous acquisition study has addressed the choices children make in production, nor the choices they make in a wider range of modal subtypes (here: *ability, deontic, teleological, future, epistemic*). Despite polysemy, not all modal lexemes are appropriate for all flavors (i.e., *Don't show Eddy pictures of spiders, he***should/might get scared*). To my knowledge, the current study is the first to experimentally examine both syntactic category choices (v/V/AUX) and semantic error patterns in the acquisition of modal lexemes.

What errors do we expect children to make when prompted to provide or choose between modal lexemes? In diachronic linguistics it has been proposed that child learner errors are responsible for innovations we see in the historical record (e.g., Kiparsky 1974; Lightfoot 1979; Clark & Roberts 1993), which suggests that error patterns should be consistent with historical innovations. This hypothesis has not yet been explicitly tested using child data. I assume all children will show systematic mapping errors during the course of acquisition; those errors which remain unchecked are the source of innovations in the process of language change. Further, change is unidirectional, suggesting that learners' structural mapping errors should correlate with historical reanalyses and drive directional change.

Van Gelderen (2004)'s Late Merge Principle (LMP) and Roberts & Roussou (2003)'s principle of Upwards Reanalysis (UR) aim to capture the same directional historical bias for elements to merge higher in the structure in the innovating grammar than in the conservative grammar. Van Gelderen argues that merging as late in the derivation as possible (= as high as possible in the tree) is a learning strategy to avoid costly movement operations (based on general rules of economy; see Chomsky 1995). Roberts and Roussou argue that upwards reanalysis reduces to loss of movement; the lower merge position is lost in favor of directly merging high. Modals are a good domain to study the proposals for the role of acquisition errors in change because they are well documented historically (Jesperson 1924; Traugott 1989; Roberts 1985; Bybee, Perkins & Pagliuca 1994, among others). Cross-linguistically modal lexemes travel a known pathway, moving from flavor to flavor over time, as illustrated by English in (3). Individual lexical items change over time and are concurrently or subsequently replaced by renewing items in a cycle of change (see van Gelderen 2004, 2009, 2010, 2011).

(3) Attested Modal Pathways² (based on Bybee, Perkins & Pagliuca 1994; OED):

²Earlier/older meanings may be retained even after new meanings develop; however, loss appears to be from older to newer meanings when it occurs.

- a. $AUX \underline{must}_{EPISTEMIC} \leftarrow Middle English AUX \underline{must}_{DEONTIC} \leftarrow Old English V. \underline{mote}_{PPT}$ 'permission, real-world opportunity'
- b. AUX <u>can_DEONTIC</u> \leftarrow Middle English AUX <u>can_ABILITY</u> \leftarrow Old English V. <u>cann. PPT</u>³ 'to know' \leftarrow Germanic <u>kunnan</u> (kann, kunþa) 'to know intellectually'
- c. $\emptyset \leftarrow$ Early Modern English AUX <u>shall_FUTURE</u> \leftarrow OE V. <u>sceal.PPT.DEONTIC</u> 'obligation' \leftarrow Germanic *<u>skel</u>- 'to owe money'

Lexical pathways are remarkably similar cross-linguistically and follow the Modal Cycle (Gergel 2009). This cycle comprises a syntactic trend from content verb to auxiliary (4a), and a semi-independent semantic trend from lexical meaning to functional, and within functional meanings from root to nonroot modalities (4b). The root/nonroot distinction can be represented with two separate heads, one below T (Mod_{Root}) and one above (Mod_{NonRoot}) (Hacquard 2006, 2010; Heizmann 2006; van Gelderen 2010:135; cf. Cinque 1999; Roberts 2010). The structure in (4c) corresponds with the historical upwards movement trend where root meanings precede nonroot meanings and verbs precede auxiliaries. Movement may be overt or covert, and syntactic and semantic changes need not be fully in sync (see Tollan 2013).

- (4) a. Observed syntactic pathway: AUX \leftarrow Functional V \leftarrow Content V
 - b. Observed semantic pathway: Non-Root \leftarrow Root \leftarrow Content Item
 - c. Structure: $[Mod_{NonRoot} \dots [T \dots [Mod_{Root} \dots [v [V]]]]]$

Such recurrent directional steps in diachrony are argued to result from the L1 mapping process. If the child learner is responsible for cyclic changes, then the learning mechanism must be assumed to be biased in such a way as to create these directional changes under the right circumstances. Contemporary learners should be biased to treat current modals in an upwards fashion during the course of acquisition.

What specific types of errors do we expect children to make in the process of acquiring modals? This study tests two interrelated hypotheses. First, a semantic hypothesis: The error patterns of children will show lexemes like *can* extending upwards from root domains (e.g., deontic) to nonroot domains (e.g., epistemic) where adult controls prefer established epistemic lexemes like *might*. The opposite direction, nonroot to root, is not predicted. Second, a syntactic hypothesis: Child error patterns will show syntactically low elements, for example, lexical verb *like* or functional verb *have*, used in contexts where adult controls prefer established higher elements, for example, auxiliary *can* or *must* respectively. The opposite direction, high to low, is not predicted.

I present a new study that tests these hypotheses in two experiments: a production-based sentence-repair task and a comprehension-based preference task. These tasks were designed to study the acquisition of abstract, very "hard words" (Gleitman et al. 2005) by testing an aspect of modal acquisition that has as yet remained open: the acquisition of lexically linked modal semantics according to flavor. In addition, I investigate the relationship, proposed to be causal, between lexical mapping errors and known diachronic reanalyses.

³PPT = present preterite, likely meaning 'I have learned; put to knowledge.'

2. STUDY

2.1. Participants

Sixteen monolingual English-speaking children from Toronto participated in the study. They ranged in age from 4;9 to 6;4 (M = 5;5, SD = 5.36). Five-year-olds were chosen because it is uncontroversial that the majority of children this age can compute epistemic meanings to some degree (e.g., Papafragou 1998). Furthermore, if child learners are responsible for historical innovations, then errors that pattern with directional change would have to be seen late in acquisition. In addition, 16 adult controls (18–25 years old) participated. Dialects of English, even within a dialect group such as Canadian English, vary with respect to modal usage (Tagliamonte and D'Arcy 2007). For this reason, adult controls were screened to ensure that they were from the same speech community as the target group, with no L2 learning until after age 7.

2.2. Experiment 1: Sentence-Repair Production Task

A sentence-repair task was designed to elicit modal verbs from young children. This task tested whether children map modal lexical items to various flavors in the same manner as adults, or if they deviate from adults in accordance with the hypotheses. In order to support the hypotheses, children are expected to make lexeme-to-context mapping errors in the direction of known diachronic changes. This task offers a broad initial sketch of different syntactic and semantic expressions of modality as children choose them in experimentally controlled contexts.

2.2.1. Methods

The child was introduced to Elmo and his dog, Zappy, who likes to bark. Both characters and story images were presented on a laptop. After telling a brief story to the child, the experimenter asked Elmo a question. Zappy always barked over the portion of Elmo's response where one would expect either a modal verb or auxiliary. The child was then prompted to repair Elmo's obscured response with, "Zappy barked! What did Elmo say?" For example, one story showed a picture of a scaly tail coming out of a cave with villagers looking on. The experimenter said, "Oh my! There is a big scaly tail coming out of a cave. What do you think, Elmo?" to which a sound file of Elmo speaking replied, "*It* <*woof woof>> be a dragon*." The target sentence-repair was, "(*Elmo said*), '*it must be a dragon*."

The task partitioned the modal space into five flavors with known diachronic behavior: in order of diachronic emergence, *ability* > *deontic*, *teleological* > *future*, *epistemic* (e.g., Bybee, Perkins & Pagliuca 1994). Each condition can be viewed as a snapshot of a stage on the semantic journey of a modal lexeme through history. The root conditions represent early stages, with ability readings generally emerging before deontic and/or teleological, while the nonroot conditions represent late stages. Recall that this root \sim nonroot split corresponds to a generally accepted semantic divide localized to two different syntactic heads.

There were 4 test items per condition (5 in the epistemic condition). The conditions divide into 3 root conditions (*ability, deontic, teleological*) and 2 nonroot conditions (*futurity, epistemic*).

There were 4 warm-up training items followed by the 21 test items in semi-randomized order. Note that more than one lexeme could be considered target in most cases.

2.2.2. Results

The response rates were 98.5% for adults and 84.8% for children. Overall, children used more variability than adults. Let's consider each condition in turn (Tables 1–5). In each table, the results are given by frequency per group (adult vs. child). The sentence frames that were used to elicit modal responses are provided under "Target Items." Under "Response Form" all responses that occurred more than once are provided. Target response forms are bolded, and nontarget responses are coded under "Response Type" as either upwards, downwards, or other (*Copula, Inflection*, etc.). Verbs were coded as upwards if they represented a lower syntactic choice than is established in the adult language. For example, in the ability condition *know how* is a syntactically lower and semantically more contentful choice than the target *can*, its use instead of *can* is thus an upwards choice. Use of *could* in the ability condition represents the use of a typically epistemic modal in a root condition and was coded as downwards.

In the ability condition the target response was *can* (*He can count to ten*). All of the stories consisted of ability contexts where the character was able to do something. Both adults and children responded mostly with target *can*. The most common other responses were *know how* and *could*. Children also produced present tense inflected verbs that did not fit the sentence frame (*He* \emptyset *counts to* 10).

Target items	Response form	Response type	Adult	Child
Mr. Bird fly.	know how	Up	2 (3%)	3 (8%)
<i>He count to 10.</i>	can	Target	61 (97%)	23 (59%)
Julia reach higher.	could	Down	-	4 (10%)
She swim.	PRES	Inflection	_	9 (23%)
	Total		63	39

TABLE 1
Responses to the Sentence-Repair Task in the Root Ability Condition

TABLE 2

Responses to the Sentence-R	Repair Task in	the Root De	eontic Condition
-----------------------------	----------------	-------------	------------------

Target items	Response form	Response type	Adult	Child
	s'posta	Up	_	3 (7%)
<i>He stay up past bedtime.</i>	can	_	25 (42%)	15 (33%)
She play only after dinner.	should	-	11 (19%)	3 (7%)
Andy put on his mittens.	must	-	8 (14%)	1 (2%)
She wear ballet slippers.	have	-	7 (12%)	7 (16%)
	need	-	6 (10%)	_
	could	Down	2 (3%)	3 (7%)
	IMP	Inflection	-	13 (29%)
	Total		59	45

Target items	Response form	Response type	Adult	Child
	want	Up	_	3 (6%)
She escape through the window.	can	Target	29 (50%)	14 (30%)
He eat pizza.	could	Target	20 (34%)	12 (26%)
Sandy play guitar.	might	Down	2 (3%)	1 (2%)
He go swimming.	should	Deontic	7 (12%)	5 (11%)
	would	Hypothetical	_	2 (4%)
	IMP, PRES	Inflection	-	7 (15%)
	Total		58	47

TABLE 3 Responses to the Sentence-Repair Task in the Root Teleological Condition

TABLE 4
Responses to the Sentence-Repair Task in the Nonroot Futurity Condition

Target items		Response form	Response type	Adult	Child
		want can	Up Up	2 (3%)	2 (4%) 2 (4%)
Sam fall in the water	_	might will	Target	28 (47%) 20 (34%)	10 (19%) 14 (26%)
Jamie answer the phone.		could	Target	3 (5%)	4 (8%)
It rain.		gonna	Target	1 (2%)	8 (15%)
Alex eat the cake.		should	Deontic	5 (8%)	7 (13%)
		would	Hypothetical	_	4 (8%)
		PRES	Inflection	-	2 (4%)
		Total		59	53

TABLE 5	
Responses to the Sentence-Repair Task in the Nonroot Epistemic	Condition

Target items	Response form	Response type	Adult	Child
	can	Up	2 (3%)	1 (2%)
The middle one be the king.	have	Up	_	2 (3%)
He be somewhere!	must	Target	47 (60%)	7 (11%)
It be a dragon.	might	Target	17 (22%)	20 (33%)
It be Cookie Monster calling.	could	Target	7 (9%)	7 (11%)
It be a lizard.	would	Hypothetical	4 (5%)	4 (7%)
	is	Declarative	1 (1%)	16 (26%)
	PERI	Periphrastic	_	3 (5%)
	Total		78	61

In the deontic condition, the stories consisted of parents giving their children obligations/permissions. Many modals lexicalize the deontic space of English, with *can* the most common. For example, *must*, *have* (*got*) *to*, *need to*, and *should* express degrees of strong obligation (*Andy must/should/has to put on his mittens*), while *can* expresses weak permission (*Andy can put on his mittens*). Among the target responses, *can* was most common. Adults used *must*, *should*, and *need to* relatively frequently, but children did not. Both groups used similar rates of *have to*. The most common unexpected responses were *sposta* (= *supposed to*) and *could* (*Andy is sposta/could put on his mittens*. Children also produced imperative mood verbs that did not fit the sentence frame ("Andy Ø wear mittens!).

In the teleological condition the stories consisted of characters that wanted to satisfy some goal. Two possible options were apparent in the story. In one story, a mouse is trapped in a house and wants to get out. There is an open window upstairs and a tunnel into the garden. The experimenter says to Elmo, *Oh no! Ms. Mouse is stuck in the dollhouse. She doesn't see a way out. What do you think, Elmo?* and Elmo responds, *She <<woof woof>> escape through the window*! The target responses were *can* and *could*. Other responses included *should*, which probably reflects a deontic interpretation of the story. Children also occasionally used the present tense or the imperative mood.

The stories in the future condition foreshadowed an impending possible event. In one story a little boy, Sam, and his father are fishing, and the boy is leaning off the back of the boat to look at a fish. The boy's father looks scared. The experimenter asks Elmo, *Why does Sam's father look scared*? to which Elmo responds, *Because Sam <<woof woof>> fall in the water*! The target responses were along a continuum of force. The modals *might* or *could* express weak future possibility while *will* and *gonna* express strong future probability. The majority of responses, especially for adults, were target. Adults used mostly *might* while children used mostly *will*. Nontarget responses included *should, would, wants to, can,* and the present tense.

In the epistemic condition the stories set up a scenario where Elmo would have to use the available information to guess at the correct answer (It <<woof woof>> be a dragon described in the previous Methods section). The target responses were *must*, *might*, or *could*. *Must* entails a stronger conviction than *might* or *could*. The most common response for adults was *must*, while the most common response for children was *might*. Some adults and children also used *would*, which has a presentational or hypothetical feel (*It would be a dragon*). Children also produced copular sentences that did not fit the sentence frame (*It* <u>*be is a dragon*!).</u>

The task left open the choice of verbs or auxiliaries to fill the sentence gap, allowing group preferences to appear. The *AUX* category includes those modals with auxiliary syntax (see Roberts 1985), while the *functional* category included verbs that have distinct functional meanings when they take a CP complement (versus their less grammaticalized lexical meaning when taking DP complements). The *lexical* category included verbs that do not change meaning regarless of whether they take DP or CP complements (see Harley 2004; Harves and Kayne 2012). The results for the syntactic category choices are provided in Tables 6 and 7 for root and nonroot contexts respectively. In root contexts children relied on inflecting the main verb and also relied more on main verbs than adults. Differences between adults and children were highly significant ($\chi^2 = 54.63$, df = 3, p < 0.001). Examination of the residuals showed that only the inflection category had a major contribution to the chi square results.

In nonroot contexts children used the copula *is* to convert the modal context to a nonmodal context (e.g., *He is be the king*), despite incompatibility of *is* with the syntactic frame. They also

Group	AUX	Functional	Lexical	INFL	Total			
Adult	172 (91%)	13 (7%)	4 (2%)	0	189			
Child	84 (62%)	13 (10%)	10 (7%) like_love	29 (21%) PRES	136			
Lexemes	would, could	going supposed	know (how)	IMP				

TABLE 6 Syntactic Category by Group: Root Contexts

TABLE 7 Syntactic Category by Group: Nonroot Contexts

Group	AUX	Functional	Lexical	COP/INFL*	Total
Adult	137 (98%)	1 (<1%)	1 (<1%)	1 (<1%)	140
Child	80 (72%) can, might,	11 (10%) have, need,	2 (2%) like, love,	18 (16%) is, PRES	111
Lexemes	must, should, would, could	going	know (how)		

*In the Nonroot contexts inflection of the main verb was rarely used (only two instance, both by children); rather copular *is* was used. I have included both in the same column as both are instances of T.

relied more on the so-called quasi-modals *have* and *going* (or *gonna*), than did adults. While adults varied in their syntactic category choices in the root contexts, they used almost only auxiliaries in the nonroot contexts. Differences between groups were highly significant ($\chi^2 = 35.98$, df = 3, p < 0.001). However, only the copula/inflection category had a major contribution to the chi square results.

The unexpected responses that did not fit the sentence frame (the present tense, copula, and imperative) create categories present only in the children's data for syntactic category choice because adults always obeyed the rules of the task; by looking only at expected syntactic categories (lexical, functional, AUX), we can more directly compare children to the adult control group for syntactic category. With the non-frame-fitting responses removed, the between-group differences remain significant (root: $\chi^2 = 10.95$, df = 2, p = 0.004, nonroot: $\chi^2 = 12.33$, df = 2, p = 0.002). An examination of the residuals shows that in the nonroot condition, the choice of functional verbs by children approaches significance (p = 0.058; critical value at 2 degrees of freedom = 5.99, R = 5.67). In the root condition, the choice of lexical verbs by children is less robust (p = 0.09; critical value at 2 degrees of freedom = 5.99, R = 4.82).

In sum, the main findings were: (a) children exhibited a more varied mapping from context to lexeme than did adults; (b) children opted for alternative strategies to capture the modal nature of the context; and (c) children showed a slight preference, though not significant, for directional errors consistent with the syntactic hypothesis.

2.2.3. Discussion

As expected, children's lexical choices were significantly different from those of adults. While adults preferred auxiliaries to all other options, children also used mostly auxiliaries, but at significantly lower rates than adults. Unexpectedly, children used high rates of present tense and imperative mood in the root modalities. These choices did not fit the sentence frame but were nonetheless appropriate for the semantics of the context. This is because present tense *Mr. Bird flies* (sentence frame: *Mr. Bird ____fly* with target *can*) manages to capture ability by extension. Likewise imperative mood *Put on his mittens*! (sentence frame: *Andy___put on his mittens*!)⁴ in the deontic context captures obligation in an alternative, more interactive, manner.

Similarly, in the epistemic condition children used copular is 16% of the time (*The middle* one <u>_____</u> be the king \rightarrow The middle one is be the king). Children also showed elevated rates of might (33%; 22% for adults), and pointedly lower rates of must (11%; 60% for adults). This shows children using factual is and existential might but not universal must. Recall Hirst and Weil (1982), who showed that the stronger contrast, is > may, is understood earlier than weaker contrasts like is > must or must > may. Differences between groups in quantificational force choices (declarative > universal > existential) were only significant in the epistemic condition, where they were highly significant ($\chi^2 = 34.9$, df = 2, p < 0.0001) (cf. Hirst & Weil, who found deontic to be later than epistemic with respect to quantificational force acquisition).

Recalling that directional change is stepwise and upwards [Mod_{NonRoot} \leftarrow [T \leftarrow [Mod_{Root} \leftarrow [v \leftarrow [V]]]]], root modals diachronically come from content verbs. Therefore, regular content verbs (e.g., *like, know (how)*), which are candidates for renewal of the modal cycle, may be used by learners modally. The syntactic hypothesis predicts, in accordance with upwards reanalysis, that children will be biased toward using the lowest and historically earliest category, lexical verbs, in root contexts where adults prefer higher elements, AUX or functional verbs. It also predicts that children will be biased toward using the intermediate category of functional (i.e., somewhat grammaticalized) verbs in nonroot contexts where adults prefer the highest category, AUX. We thus expect to see more lexical verbs and functional verbs for child responses in root and nonroot contexts respectively.

Children did use more lexical verbs (e.g., *like*) than adults in root contexts (7% to 2%), and more functional verbs (e.g., *have*) in nonroot contexts than adults (10% to <1%). Children showed an interesting pattern: more lexical verbs in root contexts (LF evaluation at Mod_{Root}) and more functional verbs in nonroot contexts (LF evaluation at Mod_{Root}). While these findings are not significant, they suggest that children can extend lexical verbs to Mod_{Root} for evaluation. Likewise, elements that are functional already move to Mod_{Root} (*have, need*) in the adult language, and thus children using them in $Mod_{NonRoot}$ constitutes an extension further up the tree.

The semantic hypothesis is more difficult to assess with regards to the results of the sentencerepair task. The alternative, nonmodal, choices that children employed (present, imperative, and copular declarative) show that they are generally attuned to the target semantics but do not necessarily employ modal verbs to cover the ability, deontic, and epistemic meanings. However, for frame-fitting errors, there appear to be as many downwards errors as upwards errors, and many

⁴The child's response was only coded as imperative when s/he pointed at the relevant character and/or expressed forceful intonation patterns.

of the errors conflate both syntax and semantics (*know how* instead of *can* in the ability condition constitutes both the use of a more semantically contentful element and the use of a lower syntactic category). A preference task was designed to help better address the semantic hypothesis.

2.3. Experiment 2: Preference Task

In order to more precisely assess the role children may play in upwards reanalysis, a lexical preference task was designed to test whether children preferred extending root lexical items into epistemic contexts over the opposite. The hypothesis that children will extend root lexemes into nonroot environments, but not vice versa, was tested using specific lexical contrasts. The same adults and children participated in this task as in the Sentence-Repair Task.

2.3.1. Methods

The child was introduced to two aliens who had just come to Earth and were learning English. An illustrated story was shown in which the aliens provided comments on the event. For example, one story showed a picture of a little boy reading a book about snakes and making a scared facial expression. The experimenter said, "This is Chris. He is reading a book about snakes. Why is he making that face?" The aliens responded to the experimenter's question with two near-identical sentences that differed critically only by the modal (*He must be scared of snakes*). The child was then asked to help the aliens by choosing which sentence sounded best.

The aliens looked identical except for color (green vs. blue). There were two lexical contrast pairs (*might* \sim *can*, *must* \sim *have*) contrasting a nonroot modal (*might*, *must*) to a root modal (*can*, *have*). There were 8 trials with 4 nonroot contexts (2 with target *might*; 2 with *must*) and 4 root contexts (2 with target *can*; 2 with *have*). There were 4 filler items; all items were presented in a semirandomized order, and which alien spoke first was counterbalanced.

2.3.2. Results

The response rates were 100% for adults and 97.4% for children. Table 8 provides a summary of the data, with error counts and percentages for both groups. The "Condition" indicates the flavor of the story, while "Lexical Contrast" indicates which two lexemes were heard in opposition. Two sample target sentences are provided per condition, one representing each lexical contrast. The competitor modal (the other member of the contrast) and what error-type preference for the competitor modal would indicate are listed for each sample sentence. Error type counts are shown separately for each lexical contrast; for example, a downward error could have been either preference for *must* in a *have* context or preference for *might* in a *can* context. Both groups had identical rates of downwards errors (18%) with comparable counts for both lexical contrasts. However, children were more likely to choose an upwards competitor modal in both lexical contrasts than were adults (14% vs. 2%).

To test the interaction between group and error types, I ran logistic mixed-effects models for the totals of each type of error. For each, I fit group (adult vs. child) as the fixed effect, and participants and items as random effects and target as the outcome variable. In the downward nontarget choices model, group was not statistically significant (child, $\beta = -0.068$, p = 0.89).

						Err	or rates
Condition	Lexical contrast	Sample target sentence	Competitor modal	E	rror type	Adult	Child
Root	must \sim have to	He has to put choco-chips in the batter.	must	Down	must in have	12	12
	$might \sim can$	I don't want it, you can drink it.	*might		<i>might</i> in <i>can</i>	11	10
					Total	23 (18%)	22 (18%)
NonRoot	must \sim have to	He must be scared of snakes.	?have to	Up	have in must	1	9
	$might \sim can$	She might 've hurt herself on the swings.	*can		can in might	1	9
		. 0			Total	2 (2%)	***18 (14%)

TABLE 8 Error Rates for Condition Across Groups in the Preference Task

This indicates that a child is only 1.1 times less likely to pick the target than an adult in the downward error condition. On the other hand, in the upwards nontarget choices model, group was highly significant (child, $\beta = -2.624$, p = 0.002). The log odds indicate that a child is ~14 times more likely to pick the upwards-extended error than an adult. In sum, above and beyond participants and item effects group was highly significant for the upwards error condition.

2.3.3. Discussion

For the *might* ~ *can* contrast, both *might* and *can* are auxiliaries; however, *might* is exclusively nonroot⁵ (Mod_{NonRoot}), while *can* is primarily used in root contexts (Mod_{Root}) (e.g., Hacquard & Wellwood 2011). Children preferred *can* in epistemic contexts where adults preferred *might* (in fact, in contexts where *can* is ungrammatical), providing evidence for a learner bias towards extending root (= low) modals upwards to cover nonroot domains. In accordance with the semantic hypothesis, children were more likely to use *can* in epistemic contexts than *might* in root contexts.

With the *must* ~ *have* contrast, *must* is an auxiliary that is primarily epistemic in Toronto English (Mod_{NonRoot}), while *have* is a functional verb that is primarily deontic (Mod_{Root}) (Tagliamonte & D'Arcy 2007). The fact that children chose *have* in epistemic contexts where adults preferred *must* supports the semantic hypothesis since the child learners extended a deontic lexeme into an epistemic context. Likewise, the syntactic hypothesis may be supported because children chose a functional verb *have* instead of the established auxiliary *must*, showing movement of *have* to Mod_{NonRoot} by LF. These child extensions are consistent with historical change

⁵There is the possibility of so-called metaphysical readings of *might* (see Condoravdi 2001). In usage, however, *might* appears to be nearly exclusively epistemic; in a large-scale corpus study, *might* occurs in no clear-cut metaphysical cases (Hacquard & Wellwood 2012).

pathways for modal verbs. The semantic and syntactic pathways are in sync for *have* replacing *must*.

Upwards rates for *can* and *have* were identical, showing that the lexical contrast was not significant. High rates of downwards errors, contra the hypotheses, are nevertheless consistent across groups. These rates are largely due to preference choices for *must* in deontic contexts. These are grammatical because modals, like *must*, retain earlier meanings when they grammaticalize. Thus *must* is primarily epistemic but retains its deontic readings in Toronto English (Tagliamonte & D'Arcy 2007). Use of *must* in root contexts is nevertheless unexpected, particularly for children, in view of deontic *must*'s more formal register than deontic *have* (compare with Fond 2003 and Heizmann 2006, who found a slight preference for deontic readings of *must*, consistent with the findings). Child downward rates match adult downwards rate and are in keeping with the lexicalization patterns of modals in synchronic adult Toronto English.

I have assumed throughout that when a child uses a root modal where an adult would use an epistemic one, she does so intending an epistemic meaning (e.g., she uses *can* intending *might*) and thus extends the meaning of the root modal. It is important to bear in mind the possibility that children use root words in these particular contexts and actually intend root meanings. Children may differ from adults not in their lexical choices but in their interpretation of the semantic context provided. This potential confound relates to the semantics-pragmatic interface (see for example Papafragou 2006). However, so long as the learner's choices are compatible with directional change—regardless of the underlying cause for those choices—the evidence supports the proposal that children play a role in diachronic pathways. Future research is needed to investigate the cause for directional biases in child language.

In sum, between group findings, such as a significant child learner bias toward upwards errors in a lexical preference task and a preference that approaches significance for lexical verbs and functional verbs in root and nonroot contexts respectively in the sentence repair task have provided some preliminary data suggesting that children may have a systematically biased learning mechanism for solving complex mapping problems.

3. CONCLUSION

Despite the compelling nature of the child reanalysis proposal and its success in the field of generative historical linguistics, there has been a lack of comprehensive exploration in L1; in other words, this theory has not accrued sufficient evidence in the domain where it applies. Likewise, acquisition research is rarely concerned with the child learner's potential role in diachronic change except anecdotally (e.g., Snyder 2007:179). In this article, I hope to have shown that the wealth of data from diachronic research, coupled with the generative proposal that children are innovators, may provide insights into the lexical mapping problem. I have supplied initial data showing that child learners make lexical mapping errors that appear consistent with known directional changes.

It has been my driving assumption, along with other researchers in the field of generative historical change, that the child's learning strategy for dealing with the input is biased in a manner that gives rise to the directional changes we see in cyclic-type changes. The ubiquity of cyclic change may thus be caused by systematic forces at work in L1 acquisition. Future research needs to formally model and test the child's learning strategy in order to better understand the

root causes of acquisition-driven reanalysis. To this end, further modeling, experimentation, and naturalistic study on modal verbs is currently underway.

ACKNOWLEDGMENTS

I owe a debt of gratitude to Ana-Teresa Pérez-Leroux, Mihaela Pirvulescu, Michela Ippolito, Yves Roberge, Derek Denis, Pavle Levkovic, Sandrine Tailleur, Bronwyn Bjorkman, Elizabeth Cowper, Elly van Gelderen, Igor Yanovich, Elaine Gold, Rebecca Tollan, Serge Hervouet-Zeiber, the acquisition and psycholinguistics groups at the University of Toronto, the audiences of *Grammaticalisation 2013* (Université de Rouen), CLA 2012 (Wilfred-Laurier University), TOM 5 (University of Ottawa), Methods in Dialectology 2011 (University of Western Ontario) and DiGS XIII (UPenn), and three anonymous reviewers. Any errors and all final decisions are my own. I would also like to extend a warm thank you to the parents, daycare directors and teachers, and especially the children who made this work possible.

REFERENCES

- Bascelli, Elisabetta and Maria Silvia Barbieri. 2002. Italian children's understanding of the epistemic and deontic modal verbs dovere (must) and potere (may). *Journal of Child Language* 29. 87–107.
- Bybee, Joan, Revere D. Perkins and William Pagliuca. 1994. The evolution of grammar: Tense, aspect, and modality in the languages of the world. Chicago: University of Chicago Press.
- Byrnes, James P. and Michelle A. Duff. 1989. Young children's comprehension of modal expressions. Cognitive Development 4. 369–387.
- Chomsky, Noam. 1995. The minimalist program. Cambridge, MA: MIT Press.
- Cinque, Guglielmo. 1999. Adverbs and the universal hierarchy of functional projections. Oxford: Oxford University Press.
- Clark, Robin and Ian Roberts. 1993. A computational model of language learnability and language change. *Linguistic Inquiry* 24(2). 299–345.
- Condoravdi, Cleo. 2001. Temporal interpretation of modals: Modals for the present and for the past. In David Beaver, Stefan Kaufmann, Brady Clark and Luis Castillas (ed.), *The construction of meaning*, 59–88. Palo Alto, CA: CSLI Publications.

Copley, Bridget. 2002. The semantics of the future. Cambridge, MA: Massachusetts Institute of Technology dissertation.

- Enç, Murvet. 1996. Tense and modality. In Shalom Lappin (ed.), The handbook of contemporary semantic theory, 345– 358. Oxford: Blackwell.
- Fond, Marisa. 2003. Deontic and epistemic modal expression: Theory and acquisition in English and Spanish. Ms. Smith College, Amherst.
- Gergel, Remus. 2009. Rather: On a model cycle. In Elly van Gelderen (ed.), *Cyclical change*. Amsterdam, The Netherlands: John Benjamins.
- Gleitman, Lila R., Kimberly Cassidy, Anna Papafragou, Rebecca Nappa, and John C. Trueswell. 2005. Hard words. Journal of Language Learning and Development 1(1). 23–64.
- Hacquard, Valentine. 2006. Aspects of modality. Cambridge, MA: Massachusetts Institute of Technology dissertation.
- Hacquard, Valentine. 2010. On the event relativity of modal auxiliaries. Natural Language Semantics 18(1). 79-114.
- Hacquard, Valentine and Alexis Wellwood. 2012. Embedding epistemic modals in English: A corpus-based study. Semantics and Pragmatics 5(4). 1–19.

Harley, Heidi. (2004). Wanting, having, and getting: A note on Fodor and Lepore. 1998. *Linguistic Inquiry* 35. 255–267 Harves, Stephanie & Richard S. Kayne. 2012. Having "need" and needing "have." *Linguistic Inquiry* 43(1). 120–132.

Heizmann, Tanja. 2006. Acquisition of deontic and epistemic readings of must and müssen. In Tanja Heizmann (ed.), UMOP 34: Current issues in language acquisition (University of Massachusetts Occasional Papers in Linguistics). Amherst, MA: GLSA, University of Massachusetts.

- Hirst, William, and Joyce Weil. 1982. Acquisition of epistemic and deontic meaning of modals. Journal of Child Language 9. 659–666.
- Jesperson, Otto. 1924. The philosophy of grammar. London: Allen and Unwin.
- Kiparsky, Paul. 1974. Remarks on analogical change. In Charles Jones and John M. Anderson (eds.), Proceedings of the First International Congress of Historical Linguistics, 257–276, Amsterdam: North Holland.

Kratzer, Angelika. 1977. What "must" and "can" must and can mean. Linguistics and Philosophy 1. 337-355.

- Kratzer, Angelika. 1981. The notional category of modality. In Hans-Jurgen Eikmeyer & Hannes Rieser (eds), Words, worlds and contexts: New approaches in word semantics, 38–74. Berlin: de Gruyter.
- Kratzer, Angelika. 1991. Modality. In Arnim von Stechow & Dieter Wunderlich (eds.), Semantik/semantics: An international handbook of contemporary research, 639–650. Berlin: de Gruyter.
- Kuczaj, Stan A. 1977. Old and new forms, old and new meanings: The form-function hypothesis revisited. Paper presented at the meeting of the Society for Research on Child Development, New Orleans.

Lightfoot, David. 1979. Principles of diachronic syntax. Cambridge: Cambridge University Press.

Noveck, Ira, Simon Ho & María Sera. 1996. Children's understanding of epistemic modals. Journal of Child Language 23. 621–643.

Palmer, Frank. 1986. Mood and modality. Cambridge: Cambridge University Press.

Papafragou, Anna. 1998. The acquisition of modality: Implications for theories of semantic representation. *Mind & Language* 13(3). 370–399.

Papafragou, Anna. 2001. Mindreading and verbal communication. Mind and Language 17. 55-67.

- Papafragou, Anna. 2006. From scalar semantics to implicature: Children's interpretation of aspectuals. Journal of Child Language 33. 721–757.
- Roberts, Ian. 1985. Agreement parameters and the development of English modal auxiliaries. Natural Language and Linguistic Theory 3. 21–58.

Roberts, Ian. 2010. Grammaticalisation, the clausal hierarchy and semantic bleaching. In Graeme Trousdale and Elizabeth Traugott (eds.), *Gradience, gradualness, and grammaticalization*, 45–73. Amsterdam: John Benjamins.

Roberts, Ian & Anna Roussou. 2003. Syntactic change. Cambridge: Cambridge University Press.

Shatz, Marilyn & Sharon A. Wilcox. 1991. Constraints on the acquisition of English modals. In Susan A. Gelman & James P. Byrnes (eds.). *Perspectives on language and thought*, 319–353. Cambridge: Cambridge University Press.

Snyder, William. 2007. Child language: The parametric approach. Oxford: Oxford University Press.

- Tagliamonte, Sali & Alexandra D'Arcy. 2007. The modals of obligation/necessity in Canadian perspective. *English World-Wide* 28(1). 47–87.
- Tollan, Rebecca. 2013. Modals in Western Germanic: Syntax, semantics and diachronic change. Ms. University of Toronto, Toronto, Canada.
- Traugott, Elizabeth. 1989. On the rise of epistemic meanings in English: An example of subjectification in semantic change. *Language* 65(1). 31–35.
- van Gelderen, Elly. 2004. Grammaticalization as economy. Amsterdam: John Benjamins.
- van Gelderen, Elly. (ed.). 2009. Cyclical change. Amsterdam: John Benjamins.
- van Gelderen, Elly. (ed.). 2010. Features in reanalysis and grammaticalization. In Elizabeth Traugott & Graeme Trousdale (eds.), *Gradience, gradualness, and grammaticalization*, 129–147. Amsterdam: John Benjamins.
- van Gelderen, Elly. 2011. The linguistic cycle: Language change and the language faculty. Oxford: Oxford University Press.
- Villiers, Jill G. de & Peter A. de Villiers. 2000. Linguistic determinism and the understanding of false beliefs. In Peter Mitchell & Kevin Riggs (eds.), *Children's reasoning and the mind*, 191–228. Hove, UK: Psychology Press.

Wells, Gordon. 1985. Language development in the pre-school years. Cambridge: Cambridge University Press.