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Mind & Language, ISSN: 0268-1064
Vol. 13. No. 3 September 1998, pp 370–399.

The Acquisition of Modality: Implications for Theories of Semantic Representation

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Abstract: The set of English modal verbs is widely recognized to communicate two broad clusters of meanings: epistemic and root modal meanings. A number of researchers have claimed that root meanings are acquired earlier than epistemic ones; this claim has subsequently been employed in the linguistics literature as an argument for the position that English modal verbs are polysemous (Sweetser, 1990). In this paper I offer an alternative explanation for the later emergence of epistemic interpretations by linking them to the development of the child's theory of mind (Wellman, 1990); if correct, this hypothesis might have important implications for the shape of the semantics of modal verbs.

It is widely acknowledged in the linguistic literature that modal expressions may be used to communicate at least two broad clusters of meanings: epistemic modal meanings, which deal with the degree of speaker commitment to the truth of the proposition that forms the complement of the modal, and deontic modal meanings, concerned with the necessity or possibility of acts performed by morally responsible agents, e.g. obligation and permission (Lyons, 1977; Kratzer, 1981; Coates, 1983; Palmer, 1986, 1990; Sweetser, 1990; Bybee and Fleischman, 1995). The utterances in (1) and (2) (on their preferred interpretations) are examples of epistemic and deontic modality respectively:

(1) (a) You must be John's wife.
  (b) That may be the postman. (on hearing the doorbell)
  (c) If you are interested in studying the mind, lectures in Linguistics should prove interesting.
(2) (a) I must go on a diet soon.
  (b) You may leave the room only after having signed these papers.

I wish to thank Deirdre Wilson, Neil Smith and an anonymous referee for *Mind and Language* for comments and suggestions. I am also grateful to the audience of the 1997 Autumn Meeting of the Linguistics Association of Great Britain, where I first presented my thoughts on the acquisition of modality. The research for this paper was partly supported by a grant from the A.G. Leventis Foundation.
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(c) Full credit should be given to the city authorities for having done so much for the environment.

Apart from the epistemic/deontic distinction, a third main area of modal meaning is often recognized: so-called dynamic modality, which includes the notional categories of real-world ability, possibility and intention/willingness (von Wright, 1951; Palmer, 1990):

(3) (a) My son can speak four languages.
(b) I will become the best skier in the world.

Normally, deontic and dynamic uses are grouped together under agent-oriented modalities (to be distinguished from speaker-oriented, i.e. epistemic, modalities—cf. Bybee and Pagliuca, 1985; Bybee, Perkins and Pagliuca, 1994; Bybee and Fleischman 1995), or root modalities (Bybee, 1988; Sweetser, 1988, 1990; Traugott, 1989). In the present discussion, I will adopt the root/epistemic distinction, although this does not always correspond to the terms used in the literature on modality.[1]

An interesting fact about the root and epistemic types of meaning is that they often tend to be expressed by a single class of modal expression in the languages of the world (for cross-linguistic evidence, see Fleischman, 1982; Perkins, 1983; Traugott, 1988; Traugott and König, 1991; Bybee, Perkins and Pagliuca, 1994). Probably the set of items for which this claim has been most extensively illustrated is the set of English modal verbs (for an overview, see Palmer, 1990), mainly *must, may, might, can, could, should, shall/will, would, ought to*; the rest of my discussion will focus on these as the best-documented area of research on modality. Modal verbs have been semantically analysed in two main ways: one strand considers them ambiguous between root and epistemic meanings (Palmer, 1990; Coates, 1983); another assigns to them a unitary semantics, which is pragmatically developed into epistemic or root interpretations in the process of utterance comprehension (Kratzer, 1977, 1981; Perkins, 1983; Groefsema, 1995; Papafragou, 1998a, 1998c). A purely ambiguous approach to the English modals can quickly be discredited because of its lack of machinery with which to motivate a connection between the root and epistemic clusters of modal meanings. On the other

[1] The reader should thus bear in mind that most of the psycholinguistic literature I am going to review uses the term 'deontic' loosely to cover dynamic uses as well; I will be consistent in my use of 'root' for both cases, unless the arguments bear directly and solely on deontic modality. A second disclaimer is also called for: I am aware that the root/epistemic distinction is a crude one, since I myself have argued elsewhere for the existence of other modal categories which do not fit this dichotomy (e.g. the alethic modality of logicians—see Papafragou, 1998a). What is more, one may distinguish different types of modal meanings even within the root or the epistemic domain. Still, the distinction will do for present purposes: after all, it is difficult enough to design experiments to test the acquisition of these broad categories, let alone more fine-grained modal meanings. I will have something to say on alethic modality in section 2.3.

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hand, a pragmatically informed monosemous analysis seems capable of unifying the traditional modal categories as aspects of utterance comprehension: on this analysis, modal verbs come out as operators, which indicate a logical relation between their complement and a set of (contextually specified) propositions which the speaker has in mind. Depending on the sort of these propositions, modal verbs will receive root or epistemic interpretations.

An interesting variant of the ambiguity approach, which has become increasingly influential in the literature on modality, is the polysemy account developed by Sweetser (1990). Sweetser places her discussion of modality within a more general approach to polysemy in language. Her basic claim is that polysemy is often motivated by a metaphorical mapping from the concrete, external world of socio-physical experience to the abstract, internal world of reasoning and of mental processes in general. She argues that modal verbs display a similar, motivated polysemy, thus rejecting the view that they are ambiguous between unrelated senses.

Sweetser uses as a basis for the semantics of the modals Talmy's (1988) notion of 'force dynamics'. Root modals are taken to encode force-dynamic notions in the external world: for instance, *may* encodes the existence of a potential but absent barrier, *must* a positive compulsion, and *can* either a positive ability on the part of the doer, or some potential force/energy. These notions are extended metaphorically into the internal, 'mental' domain and give rise to epistemic meanings: *may* and *must* thus come to denote barriers or forces operating in the domain of reasoning. On Sweetser's view, the semantic competence of speakers includes the process of metaphorical projection between the concrete and abstract domains, thereby synchronically representing motivated polysemy.

One of the arguments which are taken to support the polysemy position is that root meanings emerge earlier in language acquisition than epistemic ones (Sweetser, 1990, p. 50). The developmental argument is coupled with a historical one, whereby root meanings were the first to be encoded by specific modal lexical items, which only later came to convey epistemic modality as well. The acquisitional and historical priority of one type of meaning of a lexical item (or a lexical class) over another is standardly employed as an argument for polysemy—i.e. for the postulation of multiple, related but distinct, lexical entries in the synchronic adult lexicon—particularly in the Cognitive Linguistics literature (Taylor, 1995).

There are certain independently motivated linguistic arguments for preferring a unitary semantics over a polysemy approach to English modals, and thus for treating root and epistemic meanings as pragmatically driven aspects of utterance interpretation (Groefsema, 1995; Papafragou, 1998a, 1998b); it turns out that the polysemy approach inherits at least some of the drawbacks of the ambiguity analysis, such as the empirical inadequacy of the traditional modal categories to cover all aspects of modal interpretations. However, my main aim in this paper is not to present and defend a monosemous approach to the English modals across the board. What I want to do is examine the specific argument concerning the acquisitional priority of

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root over epistemic meanings, and outline some reasons for being sceptical about both its descriptive accuracy and its explanatory relevance to the semantics of the adult lexicon.

With respect to the former, I suggest that it is not as robust a conclusion as an initial survey of the literature would lead one to believe: there seems to be at least some counterevidence showing that young children can and do understand epistemically coloured modal items (Hirst and Weil, 1982; Noveck, Ho and Sera, 1996), or, similarly, mental terms (Moore, Bryant and Furrow, 1989; Shatz, Wellman and Silber, 1983). As for the latter, the connection between developmental facts and polysemy-based analyses may be undermined if alternative explanations are found for whatever data genuinely show an earlier appearance of root interpretations. This can be achieved in various ways (and indeed it is plausible that complex factors will interact in the acquisition of a system as complicated as the English modal set); in the course of this paper I will suggest that input data as well as performance limitations (mainly register inappropriateness) may influence the course of the child's acquisition of modality.

What I regard as the strongest explanation of the later development of epistemic interpretations, though, is my hypothesis that epistemic uses of modals mark operations on mental representations: what the speaker engages in in the examples in (1) is (potentially conscious) reflection on the content of her own mental states. In other words, successful use of epistemic modals requires the speaker to perform deductive operations on abstract propositions (i.e. on the content of her beliefs *as such*) and to arrive at a warranted conclusion. Such metacognitive abilities are, I suggest, part and parcel of the child's developing theory of mind, and as such are expected to reach an adequate level only well after the third birthday (and in fact close to 4 years of age—cf. Wellman, 1990). The elaboration of a link between epistemic modality and higher-order metarepresentational cognitive abilities yields two desirable results. On the one hand, it provides a motivated and theoretically exciting connection between early linguistic and conceptual capacities. On the other, it avoids the postulation of multiple senses for the modals in the adult lexicon: by maintaining a parsimonious, abstract semantics for modals, epistemic interpretations can be shown to arise whenever the speaker is taken to be deductively processing the contents of her beliefs *qua* mental representations in order to arrive at the proposition which forms the complement of the modal verb.

The paper is structured as follows. In section 1, I reconsider the order of acquisition of the various meanings conveyed by modal expressions on the basis of evidence from either naturalistic longitudinal studies or experimental data. Section 2 explores alternative explanations for whatever data about the acquisition of modality I take to be genuine and illuminating, focusing in particular on the theory of mind hypothesis. Section 3 sketches the implications for theories of semantic representation, considering especially the theoretical status of polysemy in natural language analyses. I

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conclude in section 4 by offering some further applications of the metarepresentational hypothesis.

1. Psycholinguistic Evidence: A Review

1.1 Naturalistic Longitudinal Studies

A number of studies focusing on syntactic aspects of modality (Brown, 1973; Kuczaj and Maratsos, 1983; Shatz, Billman and Yaniv, 1986, among others, reviewed in Shatz and Wilcox, 1991) all point to the following general conclusion: the use of English modals begins gradually, between 1;10 and 2;6,[2] often with a single negative modal form (such as *can't*) appearing in limited syntactic environments (mainly declaratives). As noted by Shatz and Wilcox (1991, p. 331), modal vocabulary growth proceeds fairly rapidly during this early period, while the range of syntactic constructions in which the modals appear changes somewhat more slowly.

Other studies set out to provide evidence about the early semantic properties of the modals. Wells (1979) is a case in point. As part of the Bristol Language Development Study, he time-sampled 60 children along with their mothers every three months from 1;3 to 3;6. Wells's general finding was that epistemic modality is acquired later than root modality. He notes that by 2;6 more than 50% of the children used *can* to convey both ability and permission; by the same time, children used *will* to communicate intention. Wells (1985) reports on a second sample of children followed from age 3;3 to 5;0. Between 2;9 and 3;0, children used *must, have (got) to* and *should* to communicate obligation or necessity, but, unlike *can* and *will*, these uses did not reach steady frequencies until later in development. In any case, by 3;3 all categories of root modality were in place. By contrast, children in his sample used *may* and *might* with a possibility meaning only by 3;3 years of age (here again, at least one occurrence from each child in half of the sample served as the acquisition metric). Use of modals to convey certainty was not achieved till much later, since by 5 only around 25% of the sample gave evidence of it. As for what Wells termed 'inferential' uses, e.g. the epistemic uses of *will* in examples such as *That will be the postman* (uttered on hearing footsteps—cf. (lb)), these seem to appear even later than expressions of certainty. Wells concludes that the acquisition of modality does not depend solely on syntactic criteria; instead, semantic properties such as the (root) indication of modulation of action or social regulations facilitate the acquisition of modality.

Shepherd (1982) notes a similar progression of semantic development in the preschool years—although she found quite frequent epistemic uses of *could* alongside the expected group of root uses. After studying a single

[2] The notation refers to years and months.

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child, she notes that *will* extends from intention/volition to prediction between 2;5 and 3;0; while *will* takes up the space of more distant future or of events in the immediate future which lie beyond the child's control, *gonna* emerges as the indicator of events in the immediate future which are controlled by the child (cf. also Gee and Savasir, 1985, although their conclusions are also based on a limited number of subjects). In another study, Pea, Mawby and MacCain (1982) found that, of 1,766 utterances containing a modal in the speech of a child between 1;11 and 3;4, only seven express epistemic modality and five of these occur after 2;8. The discrepancy seems to extend to later ages: Kuczaj's (1977) results suggest that children between 2;6 and 3;6 produce in conversation more utterances with root modals than with epistemic modals when compared to children between the ages of 4;0 and 5;9 (cited in Hirst and Weil, 1982). Corroborating findings have been reported by Perkins (1983), who has also conducted some independent research on a large corpus of spontaneous conversation among 6–12-year-old children (recorded as part of the Polytechnic of Wales Language Development Project). Perkins points out that it is only later in development that children come to fully acquire the adult modal system, especially as far as the epistemic uses of modals are concerned.

Stephany (1979/1986) is one of the few studies to include acquisitional data from languages other than English—among others, Modern Greek, Finnish and Turkish. The results she cites are in accordance with the previous findings which placed the acquisition of epistemic modality in the second half of the third year, and in fact well after the third birthday. Interestingly, Stephany broadens the acquisitional picture by reviewing developmental data concerning other expressions of modality. She observes that, in a number of languages (including Brazilian Portuguese, Italian, Modern Greek, Turkish, Swedish and Flemish), the first use of the imperfective past is not a temporal, but a modal one, serving to describe simulated activities and states and to assign roles during pretend play; a similar function is fulfilled in other languages by the conditional, the subjunctive, the optative as well as modal verbs. The age of occurrence of these devices is around 3 years—a significant point to which I will return later in this paper. Other markers of epistemic modality (the conditional in Finnish, the aorist inflection in Turkish, etc.) all seem to coincide around the third year of life.

The univocality of previous research is challenged by the findings of Choi (1995). Choi studied the speech of three Korean children and traced the acquisition of five modal suffixes. The suffixes, which belong to an obligatory class of verbal inflections called sentence-ending (SE) suffixes, occur in informal interaction and are used to mark the status of the speaker's knowledge, i.e. evidential relations. More specifically, *-ta* indicates new/unassimilated information from the speaker's point of view, *-e* marks old/assimilated information, *-ci/cyana* indicates the certainty of a proposition (or shared information), *-tay* introduces non-shared knowledge/indirect evidence (e.g. hearsay or reported speech), and *-ta* (second type) marks information new to the hearer. According to Choi, this set of evidential suffixes is acquired

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between 1;8 and 3;0 years of age in roughly the order given above. The first two occur before the second birthday, *-ci/-cyana* appears productively with the onset of the second year, and the other two follow with three-month intervals in between. Choi has also traced the acquisition of one epistemic modal auxiliary marking 'inference' and of four root modals encoding obligation, desire, ability and permission: all of them coincide developmentally between 2;6 and 3;6 years, and in any case appear much later than the modal SE suffixes.

Choi's research has been taken as *prima facie* evidence against the existence of a cognitive constraint on the early acquisition of epistemic modality (see, for example, Shatz and Wilcox, 1991, p. 332). Before we go on to some explanations, however, there are some points to be made about the interpretation of her findings. Choi herself has suggested some possible factors which may facilitate the acquisition of Korean modal SE suffixes: their perceptual salience (given their sentence-final position), their obligatoriness (and thus the richer input they provide to the acquisitional device), and their semantic consistency (they do not communicate root meanings, neither do they incorporate tense or aspectual meanings). More importantly, she is concerned with the acquisition of an evidential system rather than a modal system based on the notions of possibility and necessity. Two facts are particularly telling: firstly, not all Korean modal SE suffixes were acquired by her sample: for example, children did not produce *-kwun* (unassimilated inference based on newly perceived information). Secondly, not all the functions expressed in the adult grammar were present: *-ci* also expresses certainty of a proposition based on inference, but it did not appear with this meaning in children's speech. It is quite plausible that both evidentiality and epistemic modality turn on roughly the same *type* of cognitive abilities: in fact, I will argue later on that the latter—and possibly the former—are instantiations of the broader human metarepresentational capacity. However, epistemic modality makes stronger demands on the human metarepresentational device and it is therefore to be expected that genuine epistemic instances will emerge at more advanced stages of development.

It is important to stress at this point that, with the exception of Perkins, all of the above writers take a *semantic* root/epistemic distinction for granted; in other words, they use this distinction as a useful starting point for studying the acquisition of modal categories without worrying too much about finer distinctions of meaning. This often results in imprecision in the separation of individual root and epistemic meanings. As linguistic studies of modality have emphasized, it is often difficult to determine on a given occasion of utterance whether a modal verb should be assigned an epistemic or a root interpretation (cf. the discussion of 'indeterminacy' and 'merger' in Coates, 1983). This is not intended as a general caveat but rather as a specific criticism of approaches such as Shepherd's, which assume without argument that there can be a principled distinction between volition and prediction, or immediacy and certainty. The same argument applies with equal force inside each of the two broad types of modality: for instance,

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there seems to be little independent evidence for Wells's (1985) distinction between the 'inferential' and 'certainty' sub-types of epistemic meaning (as they appear, e.g., in *must* of example (la) above).

Another point worth mentioning with respect to naturalistic data is that they can only yield results about language production. However, the link between production and comprehension is not as straightforward as it might seem. In fact, production in children as a rule lags behind comprehension (E. Clark, 1993);[3] in other words, children avoid using parts of a linguistic system of which they already have a grasp until they feel quite confident in the system they have constructed. In an early study, Kuczaj and Maratsos (1975) demonstrated this very fact using elicited imitation with respect to the syntactic properties of the modals *can* and *will*. Inversely, very young children have been shown to occasionally use some members of a complicated grammatical system (e.g. an inflectional paradigm) correctly by simply memorizing isolated items: production there does not guarantee successful acquisition of the whole system (as is further proven by the lack of overgeneralizations). It might be the case, therefore, that children do have a grasp of epistemic aspects of modality even before they start producing independent forms (within the limits, of course, that cognitive development and other factors will determine).

Despite the scepticism expressed in the previous paragraphs, the data seem to converge on the point that the onset of epistemic modality follows that of root modality, and typically appears around or after the third year. Two types of explanation have been advanced in the literature reviewed above. The first has to do with considerations of input: it is reasonable to assume that most modal expressions produced by parents to children will have to do with permission, obligation, ability and other related notions, rather than with inference and the evaluation of the necessity and possibility of a conclusion. Although mentioned only in passing by the above authors, I believe this is a line well worth pursuing, and I will return to it in section 2. The second type of explanation has to do with factors in cognitive development, which are standardly couched in a Piagetian framework. Thus, Perkins (1983) attributes the early development of *can* and *will* in the preoperational stage to the child's egocentrism, which is also invoked to explain the absence of the more 'abstract' *must* and *may* (cf. also Choi, 1995). After 7, in the so-called concrete operational stage, the negotiation of social roles and tasks begins; this period coincides with the proliferation of expressions of root modality. Finally, from about 11 years (the formal operational stage), comes the abstract representation of alternative hypotheses and of their deductive implications, hence the productive use of epistemic modality.

Setting aside theoretical objections to the Piagetian analysis, which lie out-

[3] For different reasons, the production/comprehension gap is also manifest in adult speech.

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side the scope of this paper,[4] the basic problem with Perkins's proposal is that it gets the facts wrong. As most of the naturalistic studies have demonstrated, the first instances of epistemic modality appear around the third year, much earlier than a Piagetian account would allow. Anticipating the discussion in later sections, it can be argued on the basis of experimental studies that children already entertain and process logical possibilities by 7 years, if not earlier, thus lowering Piaget's estimated thresholds for logical reasoning in children (and the similarly high estimates of Pieraut-LeBonniec, 1980; cf. Piaget, 1928; 1987); moreover, evidence from the use of mental terms like *think, know, guess* to refer to one's own mental contents from around the age of 3 shows a type of cognitive ability which cannot be said to be tied to a simple, concrete mode of thinking.[5] In a nutshell, young children seem to be capable of handling the concept of mental representation—and related epistemic concepts—much earlier (and in much different ways) than the Piagetian framework credited them with (for detailed discussion, see Perner and Astington, 1992). I conclude that, although the child's cognitive development is naturally the place to look for constraints on the acquisition of modality, existing linguistic/developmental analyses cannot adequately deal with the range of the child's emerging inferential abilities.[6]

1.2 Experimental Studies

The oldest and best-known experiments on the acquisition of modality (at least in the linguistic literature) are those conducted by Hirst and Weil (1982). Fifty-four children between 3;0 and 6;6 were given two different modal propositions of varying strength (e.g. with a possibility vs. a necessity marker). In the epistemic cases, the propositions concerned the location of a peanut. In the root cases, they were commands by two teachers about the room a puppet was to go to. The child was to indicate in the first case where the peanut was, and in the second where the puppet would go. The strength

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[4] For a starting point, see Piatelli-Palmarini, 1980; Braine and Rumain, 1983; and Wellman 1990. Cf. also Gopnik, 1993; p. 7 for a snap argument against egocentrism.

[5] In this paragraph I have related the Piagetian stages of development to specific ages of acquisition, as the linguistic (and the majority of the psychological) literature has tended to do. Smith, 1993, argues that the Piagetian framework is more appropriately seen as predicting broad differentiation over time, rather than being tied to specific age periods. Still, Smith admits that Piaget's own empirical accounts embody conclusions about the relations of children's age to developmental level, and notes: 'At best, this evident tension merits clarification; at worst, it marks inconsistency' (o.p. p. 104).

[6] I have devoted space to the Piagetian analysis, since it is explicitly adopted by researchers who have provided longitudinal data. One might argue that a Cognitive Linguistic account would not be fundamentally different in spirit from a Piagetian account, at least in terms of the dichotomy between concrete vs. abstract operations (cf., for instance, the Piagetian accounts of Overton, 1990, and Ricco, 1990, with their emphasis on the sensorimotor origins of logical necessity and possibility).

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ordering assumed was *is* > *must* > *should* > *may*.[7] The general result was that children appreciate the relative strength of epistemic modal propositions about a year earlier than root modal propositions (5;0 vs. 6;0 years approximately); moreover, the greater the distance between the modals, the earlier the distinction is appreciated. Although these results seemingly provide arguments against previous research assigning to root meanings developmental priority over epistemic ones, the authors are careful not to draw any hasty conclusions: note that, while the epistemic tasks were pretty straightforward, the root ones depended on the child's evaluation of the authority of the persons issuing the command, as well as of the puppet's compliance with the rules, so that performance rather than competence factors might have caused the root/epistemic discrepancy. What the experiments do demonstrate, though, is that the order of acquisition of the relative modal strength is the same in both epistemic and root tests. This result suggests that the two senses of modals have not developed independently, thus offering an argument against polysemy-based (and, a fortiori, ambiguity-based) analyses.

Byrnes and Duff (1989) largely replicated Hirst and Weil's study with children aged between 3;0 and 5;0 years. Five-year-olds performed overall better than the younger age groups, while younger children performed significantly better on epistemic rather than root tasks. For reasons similar to the performance factors mentioned above, however, these results are not conclusive: the authors used a highly desirable situation from the agent's point of view in the root tasks, and the children often responded using a 'rebellion strategy', that is, going against what they clearly understood to be an order. What is a more significant finding is that children performed better with words that were familiar to them (*has to, can't*) than more formal words (*might, might not*); although commonsensical, this fact has largely been overlooked in studies of the acquisition of modality.

Yet a third study inspired by Hirst and Weil's work is that of Noveck, Ho and Sera (1996). Noveck and his associates initially replicated the original hidden-object task and checked the detection of relative (epistemic) strength contrasts in *is* > *has to* > *might* among 32 5-year-olds; the results largely confirmed Hirst and Weil's findings.[8] In a more controversial move, Noveck et al. assumed that epistemic modals like *might* and *have to* are not simply

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[7] Hirst and Weil have ignored the possibility that an utterance containing *must*, on a logical/alethic construal of the modal, is actually stronger than an unmodalized declarative—probably thinking that such an interpretation would be unavailable to children of this age.

[8] In fact, preference for *is* over *has to* was not significantly different from predictions based on chance. Various lines of explanation may be offered for this: (1) *has to* might be judged more natural (hence, more reliable) in a context where the hidden object has been out of view from the start; *is* would inappropriately suggest that the person providing the hint (actually, a puppet) possesses direct evidence for the location of the object; (2) there are many contexts in which *has to* is stronger than (entails) *is* — see previous footnote for a similar point on the *must*/*is* contrast.

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'relative force' indicators, i.e. they do not simply mark the speaker's commitment to the proposition which is embedded in the modal; these verbs also have a logical aspect, in that they mark possible or necessary inferences. They then went on to test the ability of children of various ages (5-, 7- and 9-year-olds) to appreciate the logical aspects of modals, and to compare their performance to that of adults. Subjects were presented with a hidden-object task, in which there were only two logically possible answers: subjects were in a position to infer those answers on the basis of information they were given by the experimenters. In one case, for example, the deducible assumptions were 'There has to be a parrot in the box' and 'There might be a bear in the box'. The subjects then received two conflicting pieces of information from a puppet: namely, two modal utterances varying in strength, where the strong modal utterance was in fact misleading. In the above example, they would hear *There can't be a parrot in the box* and *There might be a bear in the box*. The experimenters predicted that, if children relied solely on the relative force of the modals, they should agree with the hint carrying greater speaker certainty; if they were able to detect logical aspects of the modals, they should go along with the correct (albeit weaker) utterance. It turned out that children of all age groups performed overall correctly, with successful performance rates rising in older children.[9] Five-year-olds were better with logically necessary, rather than simply possible, conclusions, but again their scores were far better than those predictable by chance.

With their second experiment, Noveck and his colleagues have thrown some light on the use of logical inference and the evaluation of logical necessity and possibility by young children. In particular, the fact that 7-year-olds show a significant ability to detect logical possibility lowers previous estimates (going up to 9 years of age), although admittedly the experimental setting might have facilitated things considerably. I will return to these results later on. For the moment, the issue is whether the second experiment has demonstrated anything about the comprehension of epistemic modality; I think it has not. There was, I think, no difference in the comprehension of the modal utterances between the first and second experiment: both experiments involved epistemic interpretations. What did change was the range of evidence available to the subjects in either case. While in the initial series of experiments children had to rely exclusively on the puppet's hints to discover the location of a hidden object, in the second they also possessed independent information, which was apparently more reliable than any subsequent hints: since the box containing the hidden object was closed from the start, it is reasonable to assume that the puppet supplying the modal hint might not have first-hand knowledge about the object's location, and in any case, it is not as reliable as the information objectively

[9] In one variant of the task, equally 'forceful' modals were used, although only one of them was a valid hint: the prediction was that, if children rely on the relative force of modals, chance responding would occur. Even with 5-year-olds, though, the correct hint was chosen at a rate significantly greater than chance.

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presented to the children before the trial began. The subjects were thus encouraged to draw on what they knew themselves, rather than give credence to the puppet's apparent guesses. Rather than detecting a distinct, purely logical aspect in epistemic modals, the second experiment thus gives evidence of how epistemically modalized utterances can be used and evaluated as one information-source among others in a general deductive reasoning process employed by young children.[10]

Let me finally turn to Coates (1988), who tested older children's comprehension of modals with respect to the epistemic/root distinction. She asked adult, 12-year-old and 8-year-old subjects to sort cards, each containing a modalized version of the sentence *I visit my grandmother tomorrow*, into piles on the basis of similarity of meaning. Cluster analysis revealed four distinct groups in the adult system:

(a) epistemic possibility (*may, might, perhaps, possible that, probably*);
(b) possibility/ability/permission (*can, could, nothing prevents, allowed, able, possible for*);
(c) intention/prediction/futurity (*will, shall, going to, intend*);
(d) obligation/necessity (*must, should, ought, have got to, obliged*).

Twelve-year-olds also distinguished four categories, although there were some minor differences between the two subject groups as to the classification of specific items. Eight-year-olds, on the other hand, did not include a category for epistemic modality and were in general less consistent in their options as a group. Coates concludes that the mastery of the modal system is achieved at a relatively later age. There are several potential problems with this experiment, however. First, a number of her examples are indeterminate between different interpretations; for instance, *I can visit my grandmother tomorrow* can indicate both ability and permission. Second, even the adult classification imperfectly matches the range of interpretations the modals may exhibit; *may*, for example, is capable of communicating permission as well as epistemic possibility, while *probably* can be said to convey prediction as much as epistemic possibility. Third, as Coates herself acknowledges, the

[10] Although Noveck et al. can't be right in conflating logical and epistemic modality (see Karttunen, 1972 and section 2.3 below), one might argue that their identification of two separate possible paths for the acquisition of the 'inferential' component of epistemic modals is correct: one possibility is for children to derive this aspect from what they initially understand merely as a 'relative force' indicator; another (the authors' favourite) is for the appreciation of the inferential component to proceed independently of the 'speaker commitment' interpretation of epistemic modals. I frankly can't see how the second alternative would ever work. Noveck et al. seem to believe that the inferential and 'relative force' aspects of epistemic modality are truly separate; although they consider the latter pragmatic, they are vague as to how such aspects are derived from the semantic content of the modal verbs. In any case, even if their dilemma were genuine, their experiments could not, for the reasons given above, adjudicate between the two possibilities.

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linguistic construction she has used disallows certain interpretations, which are otherwise present in the language: logical necessity expressed by *must* is one example. Given that similarity is a fairly vague criterion itself, and that modals fall into various overlapping categories, it is not surprising that subjects seem to have classified modals depending on the verbs' preferred interpretations.

Overall, then, experimental evidence has been less illuminating than naturalistic studies as to the acquisition of root and epistemic aspects of modals. However, we still lack an explanation of these findings, and this is what I will start to develop in the next section.

2. *Alternative Explanations for the Acquisition of Modality*

2.1 The Theory of Mind Hypothesis

One of the most influential proposals put forth in recent years in psychology and the philosophy of mind is the theory of mind hypothesis (cf. the contributions in Carruthers and Smith, 1996). On one of its central interpretations, this hypothesis entails that part of human cognitive mechanism is the ability to know one's own mind as such, i.e. to reflect on one's mental contents and processes and to accommodate the results in a coherent commonsense theory about the mental world (the 'theory' theory; see Wellman, 1990; Gopnik, 1993). The theory of mind is based on specific ontological commitments, and is itself part of human ontological knowledge; moreover, like any decent theory, it is constructed so as to give a causal-explanatory framework to account for/predict phenomena in the mental domain (for the domain-specificity of the theory of mind, see Gopnik and Wellman, 1994). In what follows, I would like to construct an account of the acquisition of modal verbs by elaborating a link between epistemic modality and the child's developing theory of mind.

Let me start with a broad picture of the child's early understanding of mind (or metarepresentational ability, as it is commonly called).[11] Some psychological knowledge seems to be in place as early as the second year of life. Two-year-olds have a non-representational grasp of desire and perception, whereby desires are conceived roughly as drives towards objects and perceptions as awareness of/visual contact with objects. From this initial understanding of desire and perception as simple causal links between the mind and the world, 3-year-olds go on to develop a non-representational conception of belief along much the same lines. Belief contents are taken to

[11] This paragraph draws heavily on Gopnik and Wellman, 1994. I chose their account mainly for purposes of exposition, since what I want to say about modality here does not hinge on the details of existing accounts. It is an interesting issue whether modality could be used as a case study to bring out empirical differences between the 'child as a scientist' and the 'modularity' versions of the theory of mind.

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reflect the world directly (the 'copy theory', as Wellman, 1990, calls it). As a result, children of this age notoriously fail to detect misrepresentation (cf. the classic false-belief task) and are incapable of acknowledging that beliefs may have different sources or come with varying degrees of conviction. By 4;0 or 5;0 years, children seem to have developed a 'representational model of mind' (Forguson and Gopnik, 1988): almost all psychological functioning (desires, perceptions, beliefs, pretences, and images) is mediated by representations of reality. Mental representations are increasingly employed in explanatory accounts of human thought and action.

There is an obvious sense in which expressions of epistemic modality fit into a representational model of the mind: in their epistemic uses, modals like *may, might, must, should, will* and *ought to* indicate—broadly speaking—that a certain proposition is entailed by/compatible with the speaker's belief-set. The employment of epistemic modality rests crucially on the ability to reflect on the content of one's own beliefs, to take into account the reliability of those beliefs (i.e. the relative strength with which they are entertained),[12] and to perform deductive operations on them. The above processes jointly presuppose the ability to conceive of one's mental contents as representations distinct from reality, which may bear a variable degree of correspondence to the actual world, and are thus tightly linked to the shift in the child's epistemological concepts which takes place around the third year.

Significantly, one group of data which has been instrumental in the advancement of the theory of mind hypothesis consists of mental terms (e.g. *know, think, mean, remember, forget, guess, hope*, etc.): the acquisition of these terms, although distinct from, is obviously related to that of epistemic modal verbs, and might be useful in establishing a parallel between the two classes. More specifically, mental terms have been shown to arise in the spontaneous speech of children between 2;4 and 3;0 years of age (Shatz, Wellman and Silber, 1983); however, they are initially used rather as conversational devices ('hedges'), without a full command of their representational meaning, in phrases like *you know, I think*. Genuine mental state uses begin after 2;8, often in situations where the child contrasts reality to a representation of reality (a belief, a dream, etc.). Other studies report that children are able to make distinctions of relative strength between verbs like *know/be sure* and *think/guess* only by their fourth year (Moore, Bryant and Furrow, 1989; Moore and Davidge, 1989).

How can the empirical data on mental terms be brought to bear on the acquisition of epistemic modality? A first interesting correlation comes from the temporal pattern of acquisition: according to the data presented in section 1, occurrences of epistemic modality are rare before the third year, and mostly appear beyond 3;6 years. There is some indication that children use epistemic expressions such as *maybe* before modal auxiliaries (Stephany, 1979/1986, p. 395); this, however, can be viewed as an isolated rote-learned

[12] On this notion of strength of assumptions, see Sperber and Wilson, 1986/1995.

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member of a system which the child cannot as yet fully comprehend—on a par with conversational uses of mental terms (cf. the memorization of isolated parts of a complicated system in the first stages of acquisition, discussed in section 1.1).[13]

We have seen that after 4 years epistemic uses become more frequent and appear in a larger number of modal items; it is also at this period, and especially around 5;0, that children begin to understand strength distinctions among modal verbs, and between epistemic modal verbs and unmodalized declaratives (cf. the Hirst and Weil-type studies). These findings correlate pretty well with the mental verb data, and together fit the threshold of 4;0 to 5;0 for the emergence of a representational model of mind. Moreover, it makes good sense to assume that the ability to acknowledge the source of one's beliefs, to recognize one's past beliefs, and to realize that beliefs vary in strength and accuracy develop in parallel with one's ability to deductively process one's existing beliefs and to evaluate a proposition with respect to the cognitive support it receives from one's knowledge.

It is generally true that children first introduce a distinction between reality and non-reality (or representation of reality), and then proceed to make finer distinctions inside the epistemic modal space. Given at least the linguistic evidence, one would expect various aspects of metarepresentational capacities to evolve across time and surface in different grammatical structures; if we go beyond the English modal verbs to other epistemic expressions, we would expect the development of the child's theory of mind to place at least a lower bound on the emergence of hypothetical reference, conditionals, and other related constructions. It should be obvious that, far from attributing to young preschoolers the ability to perform *conscious* metacognitive reflection, my claim about their metarepresentational abilities concerns their growing ability to mentalize, i.e. to understand mental representation. In all of these cases, one must be careful to avoid circularity of argument, i.e. not to invoke the same type of data as both evidence for theory of mind and predictions following from a representational model of the mental.

Still, one might ask, if the present status of the theory of mind hypothesis entails a threshold for the appearance of metarepresentational properties, how does it account for apparent counterexamples? I have already mentioned Choi's research on Korean SE suffixes, which has led some to question the existence of cognitive constraints on the acquisition of epistemic modality and to resort to weaker hypotheses (Shatz and Wilcox, 1991; for some

[13] This deals with a potentially problematic point for my 'theory of mind' hypothesis (raised by an anonymous referee for *Mind and Language*): if theory of mind abilities are not present before 4 years (and are still developing by the age of 6;0), how can the earliest uses of epistemic modal expressions be accounted for? My answer is this: 3-year-olds have some understanding of the mental world, which allows first (incompletely understood) epistemic uses. Even after 4;0, however, metacognitive capacities develop over a long period of time, over which various aspects of epistemicity will emerge and stabilize. For instance, even within the space of epistemic modality, expressions of possibility precede those of necessity (cf. sections 2.2 and 2.3).

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weaker, supplementary acquisitional hypotheses, see next section). Choi placed the acquisition of these evidential suffixes between 1;8 and 3;0 years, much earlier than a proper theory of mind can be said to emerge. Nevertheless, in what follows I want to speculate on possible ways of reconciling her findings with what we know so far about infant cognition.

First, as stressed by Gopnik and Wellman (1994), even 2-year-olds have some notions, however vague, of internal psychological states; this is particularly evidenced by early 'conversational' interaction, facial imitation and joint-attention behaviour. Still, we wouldn't expect anything but the simplest causal relation to be recognized between the mind (particularly desires and perceptions) and the world. The Korean suffixes acquired before the second birthday are *-ta* and *-e*, which mark new and old information respectively: a first guess then might be that, given the rich input they receive, young Korean children start marking off with *-ta* information that has recently been acquired through direct perception; this is borne out in Choi's data. *-e* is reserved for a variety of functions such as past tense, questions, etc. The appearance of *-ci/-cyana* in the beginning of the second year signals certainty of information, but again it is a certainty closely associated with direct and compelling perceptual evidence. Other uses of this morpheme are reserved for marking repetitions of a previous utterance or, in Choi's terms, 'shared knowledge' between interlocutors; however, such 'shared knowledge' uses do not exactly deserve their name, since they do not actually entail any representation of what the interlocutor *knows*: if true, this would indeed refute the present formulation of the theory of mind hypothesis. Repetition, though, need differ only minimally from marking something as old information; consequently, *-ci/-cyana* need do little more than accompany a retrieval from memory. So far nothing in the Korean data necessitates a recognition on the part of the child of a mental state *as such*. This is not to say that the child does not reason about mental contents (e.g. propositions she has recently formed, or the sources thereof) but, crucially, she does not perceive these mental contents as *mental* contents.[14]

What about the suffixes which occur in the third year? I think there is a genuine qualitative change here *-tay*, a reported speech marker, serves to mark the beginnings of a representational conception of the mind, since it presupposes the ability to attribute to someone else thoughts, utterances or emotional states (corresponding uses of the suffix are documented by Choi). *-ta* (with a high pitch) was used by slightly older children for information which the child had from first-hand experience. Choi maintains that this suffix also conveys information new to the hearer: however, there is no evidence from her examples that it need be so (note that she says the same thing for indirect speech markers). What the utterances with *-ta* (Type 2) share is that they describe things a child might consider new, important or,

[14] Cf. Wellman, 1993 for a similar argument about understanding pretence vs. engaging in pretence (pretend play also appears in the second year of age).

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in general, emotionally exciting, things which she wishes to 'brag about' (in Choi's words, who admits that there is an 'affective component' in what is conveyed by this suffix). This is consonant with an emerging theory of propositional attitudes, although it by no means implies that the child is in a position to detect partial knowledge in the hearer (an ability that normally emerges much later in development). Note, by the way, that if *-ci/-cyana* truly marked shared knowledge already from the second year, there should be no reason for the lag between that suffix and *-ta*, which would involve a comparable insight into the hearer's mental state.

Undoubtedly, the acquisition of modals and evidentials is not as straightforward as my discussion of Choi's findings suggests. One probably has to take into account formal properties of individual languages as well. For instance, Stephany (1979/1986) points out that modal categories like the subjunctive in Modern Greek and the optative in Turkish appear earlier than the modal auxiliaries in English; the reason she gives is that morphological structural devices are acquired earlier than syntactic ones, since they are 'part of tightly knit lexical forms (Stephany, 1979/1986, p. 198). Similar considerations apply in the case of Korean, where SE suffixes belong to well-formedness conditions for sentences, so there is pressure to start using them even if the child has not mastered the meanings of the morphemes. Moreover, I do not want to imply that the Korean modal suffixational system is definitely *not* metarepresentational: a fuller investigation of the adult system (of which Choi gives us only a partial glimpse) might prove that it really rests on higher-order cognitive abilities—in fact, I suspect most evidential systems draw on metarepresentational abilities to a large extent. All I claim is that young children may go about using this extremely complex system on the basis of a limited cognitive machinery, and no account has convincingly demonstrated that they need anything more to do so than what the theory of mind hypothesis already presupposes.

2.2 Auxiliary Hypotheses and a Sketch

In order to predict the specific order of appearance of root vs. epistemic modal interpretations in acquisition, we have to make use of more specific supplementary hypotheses about language acquisition, which will elaborate on the broad cognitive constraints placed by theory of mind development. A commonsensical, yet controversial, suggestion concerns the role of input in the priming of root over epistemic interpretations in the preschool years. Shatz, Grimm, Wilcox and Niemeier-Wind (1990) gathered samples of maternal speech to infants of around 3 years and found that fewer than 10% of the modals used had epistemic interpretations. Similarly, Wells (1979) remarks that *will* and *can* were used by all mothers in his sample, and they were also the most frequently occurring modals; we have seen that these two verbs were the first to be acquired by the children in the sample. Other studies focusing on semantic-pragmatic aspects of modal acquisition also detect a correlation between the input children receive and the type of

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modals they produce (Shatz, Grimm, Wilcox and Niemeier-Wind, 1989; Shatz and Wilcox, 1991).

The motherese hypothesis has been largely discredited as an explanation of the syntactic aspects of language acquisition (Gleitman, Newport and Gleitman, 1984); things might be different, though, in the acquisition of word meanings, where lexical entries are mapped onto conceptual addresses. Given a certain stage in cognitive development, input could partially determine the output of the child's production by triggering assignments of word meaning. In the case of modality, it is reasonable to assume that (at least some) root interpretations lie within the cognitive grasp of young preschoolers, since they are taken to involve ability (*can*), desire (cf. volition in *will*), and later on permission and obligation (initially understood as normative descriptive statements about what is the case in the actual world; cf. the prevalent use of root *must* and *can* in the first person). The increased frequency of such terms in the children's input is bound to facilitate their acquisition.

A related argument comes from the frequently noted observation that epistemic modals, especially in English, are rather formal expressions, and would be unlikely to arise in children's spontaneous conversation (but cf. other epistemic expressions like *have to*, or mental terms). An indication that register, alongside other pragmatic limitations, may influence the use and mastery of individual modal forms, even in the absence of competence-related obstacles, is the fact that *ought to* seems to lag behind the other modals (it is used to state obligation by only 3% of Wells's (1979) sample; Coates's (1988) subjects also had difficulty with the verb). Apart from the children's unfamiliarity with epistemic modals, it is also true that children normally find themselves more often in situations where the topic of conversation has to do with permission, ability, intention or obligation, so that even after the age of 3;0 they do not produce as many utterances with epistemic modals as with root ones.

I will finally mention another independently motivated principle which may help to account for the acquisition of the root/epistemic distinction: children, in constructing their lexicon, tend as a rule to avoid synonymy; that is, when forming hypotheses about lexical entries, they try to avoid assigning the same meaning to two different linguistic forms (the 'principle of contrast'—E. Clark, 1993). This principle gives rise to the following prediction: children who have already successfully acquired mental terms will hesitate to assign epistemic interpretations to modal verbs (which they already use for a variety of root meanings) to convey the relative strength of a proposition.[15] Within each member of the root/epistemic distinction, the same principle may be used to explain why more striking oppositions in strength among modals (e.g. *must* vs. *may*) are acquired first, whereas the *is* vs. epis-

[15] 'Synonymy' is here used rather loosely: mental verbs and epistemic modals are not, of course, strictly speaking synonymous.

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temic *must* contrast is acquired later (cf. the Hirst and Weil-type experiments).

There is obviously a lot more to be said on the interplay between competence and performance factors in the acquisition of modality, and a fuller picture of the predictions of the theory of mind approach remains to be given. Before moving on to an outline of this picture, however, I want to consider a possible objection to the analysis as it stands. It might be claimed that I have presented only part of the acquisitional story. In deontic modality, to take a salient example, the individual has to compute whether something is necessary or possible on the basis of social or moral rules and regulations.[16] Such rules are distinct from representations of reality, strictly speaking, in that they constitute descriptions of an ideal/exemplary rather than the actual world. What is more, in order to be able to use root modals to *impose* an obligation or to *grant* permission (and not merely note them), the infant must possess some assumptions concerning social relations, authority, etc. Furthermore, many deontic interpretations crucially involve attitudes such as desires, preferences, intentions and goals. Now, suppose, following Premack and Premack (1994), that the basic notion of intention is not in place before 3;0 (as the theory of mind hypothesis would predict) and develops even up to 6;0 years: as for the acquisition of moral beliefs, it takes place even later. It follows that—the present literature notwithstanding—no genuine (adult-type) deontic modals can appear before these concepts are fully in place.

My reply is this: I by no means suppose that the development of the theory of mind affects only one side of the root/epistemic distinction; I also agree that some root interpretations will emerge later than others. What is crucial, though, for at least some root interpretations, is that the child may go about using them without having a fully developed representational picture of mind, while in order for epistemic interpretations to arise, this picture should by definition be emerging in the child's psychology. Let me give a sketch of how the development of modal expressions might go, which will help clarify things. The first uses of English modals appear before the third year: consonantly with what a basic desire-intention psychology would predict, 'ability' *can* and '(quasi-)intention' *will* are the first modals to be employed to a significant degree by infants. With the emergence of a preliminary copy theory of belief coincide other uses of root modals: *must* and *may* appear with increasing frequency at this stage to convey obligation and permission respectively. However, genuine deontic meanings cannot be communicated yet, since the child still conceives of the mind as a container, that is, as a simple storage place for immediate and accurate representations of reality which are, so to speak, forced upon it by external stimuli: the inability to form representations which are not identical to reality and to entertain

[16] This is a more inclusive use of the term 'deontic' than some philosophical literature might allow (cf. Kratzer, 1981).

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them as alternatives to it disallows the formation of deontic interpretations, for the reasons given in the previous paragraph. When a child utters a statement containing (root) *must* at this period, she rather intends it as a description of a normative regularity which holds in the actual, and not an ideal, world (and similarly for *may*). This seems to be corroborated by the empirical data (cf. Perkins, 1983, who reports a predominance of first-person-singular occurrences of modals at this age), and squares well with the sort of input the child receives from her caretakers.

Around the third year the use of epistemic modals and mental terms also begins, initially without full understanding of their meaning—these items are simply used as relative strength markers with no explicit representation of their inferential component. Further development of the child's theory of mind leads to the conception of the mind as a processor, that is, a device which actively constructs and handles representations of reality; conceptual developments of this type open the way to the comprehension of mismatches between one's mental constructs and the world (and, thus, to the identification of false belief, degrees and sources of belief, and so on). The child is by now capable of grasping the meaning of mental terms and of properly using epistemic modals like *may* and *might* (Wells, 1985). Between 4;0 and 6;0 the ability to calculate possibility on the basis of available data is solidified, together with an understanding of the differences in strength among modals depending on the type of inferential relation they encode (possibility or necessity): still, a full grasp of the notion of necessity, which involves checking through all possible alternatives, escapes many young children. With regard to root interpretations, the active deployment of alternatives to the actual world, and especially ideal/morally recommended alternatives, clears the way towards a proper use of deontic interpretations: apart from register difficulties, the markedly later emergence of deontic *ought to* in acquisition can be attributed to conceptual difficulties associated with the domain of ideals or morality (cf. also Harris and Núñez, 1997, p. 220).

After the sixth year the child begins to acquire a fuller understanding of modal notions, particularly of necessity, which gradually proceeds to the full-blown development of the adult modal system (see next section). On the semantic side, it is very plausible that, once the theory of mind is fully deployed, the child will reorganize former superficially used root concepts, and will trace the similarities between root and epistemic meanings based on common possibility and necessity underpinnings. By that time, the child will be able to construct a single lexical entry for most modals and treat root or epistemic interpretations as pragmatic enrichments of an underlying unitary modal semantics.[17]

[17] A fuller exposition should take into account other aspects of the acquisition of the modal system, such as the interaction with negation or the past tense.

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2.3 From Metacognition to Metalogic: The Emergence of Alethic Modality

Some further evidence for the account I have been advancing so far comes from another sort of modal notion, which logicians have termed alethic (or logical) modality. This type of modality concerns logical necessity and possibility defined independently of a thinking agent's mental contents, but in an absolute sense as relations between an (abstract) proposition and a set of propositions. The following are examples of alethic modality:

(4) (a) I have not won the Lottery yet, although I could have.
(b) It is possible that someone I know is going to win the Lottery.
(c) Winning the Lottery does not necessarily make one happy.

This type of modality is either ignored in many linguistic discussions,[18] or hastily conflated with epistemic modality. There are at least three arguments against the last move (Karttunen, 1972). First, alethic *must p* is stronger than the unmodalized *p*, since the former means that p is not just true but necessarily true (true in all logically possible worlds). Epistemic *must p*, though, is felt to be weaker than *p*, since it conveys that p follows from what the speaker knows/believes (see Hirst and Weil, 1982). Second, in modal logic *p* and *possibly ~p* are consistent. However, in natural language there is some incompatibility between the two clauses of:

(5) It isn't raining in Chicago, but it may be raining there.

Third, logically speaking, the form *must (p->q)* makes a different statement from *p-> (must q)*. Yet there is little difference between the English utterances in (6):

(6) (a) It must be that if Bill has a diamond ring, he stole it from someone.
(b) If Bill has a diamond ring, he must have stolen it from someone.

Even though they correspond to distinct types of modality, however, I believe that the ability to entertain alethic concepts is essentially of the same type as the ability to employ epistemic notions: i.e. it rests on the capacity to envisage propositional representations as entities distinct from reality which enter into specific logical relations. Moreover, it marks a more sophisticated step in this direction, in that the subject moves from entertaining thought contents and performing deductive operations on them to realizing that certain logical relations such as compatibility and entailment obtain between propositional contents in the abstract, *mind-independently*. In other words, alethic concepts presuppose the ability to reason about what is sim-

[18] Cf. Lyons, 1977, who takes such logical uses to be the products of a 'rather sophisticated and impersonal process which plays little part in ordinary non-scientific discourse' and is 'secondary in the acquisition of language' (pp. 845, 849 respectively).

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ply possible or necessary, thereby considering alternatives that are not included in the individual's knowledge but are predicted by general logical laws.

Epistemic and logical interpretations of modal expressions are often empirically hard to distinguish. Still, there seems to be some evidence for the later emergence of pure, alethic concepts in children. Although some sensitivity to logical necessity has been attributed to infants as young as 3;0 (Fabricius, Sophian and Wellman, 1987), it is generally acknowledged that children younger than 4;0 rarely take into account more than one possibility in hidden-object tasks (Sophian and Somerville, 1988).[19] It is also after 4;0 that an ability to declare a solution to a task undecidable between alternatives arises: it seems that, with training, children can recognize undecidability as early as 5;0 (Byrnes and Beilin, 1991). As other studies have shown, children at 5;0 or 6;0 have at least a receptive understanding of the necessary truth or falsity of propositions (Russell, 1982). More tellingly, though, the ability to reason about hypothetical possibilities, to generate possibilities that have not been specified in advance and to systematically collect and combine the information needed to move from a large set of possibilities to a single necessary conclusion is attributed only to much older children (7;0 to 9;0 years old—Sophian and Somerville, 1988; Byrnes and Overton, 1986; cf. Osherson and Markman, 1975 on the ability to detect contradictions and tautologies). This ordering is mirrored in the acquisition of modal terms: Perkins (1983) reports that logical (what he calls 'objectified') interpretations of expressions like *possibly, it is possible that, there is a possibility that* are acquired between 6;0 and 12;0 years.

Metalogical activities are typically conscious, or at least accessible to consciousness (Moshman, 1990). Although I have presented them separately here, I intend them to be construed as a domain closely related to metacognitive/metapsychological processes and developing in parallel with them. Although the situation is extremely complicated, one can complete the picture of the acquisition of modality offered in the previous section by venturing the following speculations: as part of the development of the child's second-order reflective capacities, and after the basic deductive abilities have been mastered, the general metacognitive process of reflecting on one's mental contents could be extended to the more advanced metalogical task of reflecting on one's logical (deductive) processing steps. The latter capacity proceeds towards freeing propositional representations from the mental repertoire of a thinking agent and viewing them as abstract entities (thereby giving rise to alethic concepts). The development of metalogic, alongside that of metacognition, is accompanied by a deeper understanding of epistemic modal concepts, to the extent that it permits a full grasp of their inferential component. An initial manifestation of the comprehension

[19] Memory limitations may also play a role in this (although for a different position, see Byrnes and Beilin, 1991).

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of logical modality comes from recognizing the solution to a problem as undecidable, when there is not conclusive evidence available—an ability which surfaces only around 6;0 years (Moshman, 1990). With the stabilization of the ability to check through all possible alternatives and its generalization across environments there emerges the concept of logical necessity, which is firmly established around 11;0 to 12;0 years. The child is then able to completely separate the logical and the empirical domain and to detect the validity of an argument based solely on its form, and not on the content of the premises. Indeed, a number of researchers have recognized that, by this time, the child's modal system closely parallels that of adults.[20]

3. Implications for the Structure of the Adult Lexicon

My aim in this section is to return to polysemy-based approaches to word meaning in general (and to English modals in particular) and to reconsider the role of developmental evidence in constructing arguments for or against these approaches.

Let me start with a couple of general remarks about the bearing of developmental arguments on adult lexical competence. At first sight, the connection is open to question. Notice that it is generally accepted that the child's lexicon falls short of an adult's; moreover, the development of specific aspects of the child's capacities is normally traced against what we know about the full-fledged linguistic capacities of adults. It would then seem peculiar to use children's competence the other way around as well, i.e. to take it as indicating something about the organization of adult competence. Acquisitional data cannot work both ways, as evidence about both the starting point and the endpoint of semantic competence.[21]

Inferences from development have been used extensively (even in the absence of extended empirical studies) in much current theorizing about lexical polysemy. As I have already mentioned in the Introduction, much research on the adult lexicon accepts that a large number of natural-language words are polysemous, i.e. they encode multiple discrete but related meanings (cf. Lakoff, 1987; Johnson, 1987; Sweetser, 1986, 1990; Langacker, 1991;

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[20] The discussion so far serves to clarify a possible confusion: one might argue that, since validity is standardly defined through alethic necessity, alethic modality is required for the successful use of root and/or epistemic modals. However, it is one thing to make a correct deduction, and quite another to understand its validity (cf. footnote 14 for a similar observation): only the first is involved in most early modal uses, and it requires logical, rather than metalogical, competence.

[21] What is more, it might be the case (as has been recently argued by Carey, 1988) that what falls under some of the child's early concepts is not simply a subset of the corresponding adult conceptual entries, but may well be—at least locally—incommensurate with them: so, in fact, looking into the child's concepts to gain some insight into adult semantic competence may be not merely a method of limited scope but a downright misleading one.

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Lehrer and Kittay, 1992). These meanings normally fall into two types: concrete, experience-based ones are considered basic, arising from embodied information and the interaction of humans with the social and physical environment; more abstract meanings arise out of basic meanings through metaphorical and metonymic processes. As currently presented, this line of reasoning crucially rests on the assumption that concrete meanings arise first in acquisition, and are the starting point for the construction of all other, more complex meanings for words.

Leaving aside the problematic content of terms such as 'concrete' and 'abstract' in this context (Papafragou, 1998a), there are two points I want to make with respect to this argument. First, as far as I can see, it repeats an assumption at least as old as decompositionalist accounts of word meanings: definitional primitives equal developmental primitives, and thus the order of acquisition of word meanings can be predicted on the basis of their internal complexity (an assumption which has been famously attacked, together with the whole decompositionalist picture; see Carey, 1982, pp. 351ff.). Precisely because of its neo-decompositionalist stance, this approach also has an affinity to empiricism—basic concepts are primarily experiential; hence, it inherits all the familiar problems of past empiricist accounts of the emergence of conceptual categories.

Let me return to the polysemy analyses of the English modals. Root and epistemic modal meanings, on these analyses, are taken to be mutually exclusive and separate semantic categories; root meanings enjoy conceptual and acquisitional priority and are related metaphorically to epistemic meanings. A polysemy-based account leaves a number of questions unanswered. First, is a metaphorical projection an appropriate means of capturing the relation between root and epistemic interpretations of modals? If the metaphorical analysis put forward by Sweetser (1990) entails a specific developmental ordering (as she believes, and as one would expect), one should be able to give some independent evidence that the onset of the acquisition of metaphor coincides with that of epistemic modality; to say simply that the manifested root/epistemic ordering vindicates a metaphorical analysis is to beg the question.

Second, how compelling is the claim that it is the whole root meaning which is projected onto the epistemic domain? One could well argue that Sweetser's account involves an unnecessary redundancy, as she assumes that metaphorical projection takes place in both the meaning of modal verbs and the type of propositions they range over; a more parsimonious account would suggest that the meaning of the modals remains constant but the child realizes that various interpretations can arise depending on the kind of proposition which forms the complement of the modal.

Third, why is it that certain modals lag behind others in acquisition? I have in mind *ought to* compared with the other root modals and *must* compared to other epistemic modal verbs. On the polysemy account, there are no obvious conceptual reasons, once other members of the same domain (root or epistemic) have already been acquired. It seems that the metaphor story can

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at most be only part of the story about the development of modal concepts in the child's cognition and communication.

To conclude, I believe that acquisitional data lend no support to a polysemy analysis: the later emergence of epistemic uses can be predicted from independent assumptions about the child's emerging theory of mind. After the full array of the adult metarepresentational capacities is activated in the child, she will be able to detect a common possibility- or necessity-based core across root and epistemic interpretations of different modal verbs, and thus rearrange their lexical entries around a unitary semantics.

One might argue that a theory of mind approach does not guarantee a monosemous semantics for modals, and that some version of a polysemy account could be made to turn on the cognitive developments I have outlined; the fact remains that no such candidate analysis exists at present. Furthermore, a new-look polysemy account would have to abandon the central contention of its present counterparts that epistemic meanings somehow rely on root ones for their construction. In any case, no version of a polysemy account could deal satisfactorily with alethic modality. If a metaphorical analysis were stretched to include alethic concepts, it would have to treat them as yet another semantically specified category, probably recognizing some similarities between these and epistemic modal concepts. Such an analysis would have no means of motivating their late appearance in acquisition, since it is unclear how a novel metaphorical mapping could be used as part of the explanation. As for other versions of polysemy accounts, they would have to circumvent at least the following obvious fact: whether modal adverbs and adjectives of the sort in (7) communicate epistemic or alethic meanings on a given occasion depends on the type of the proposition in the complement as well as on general contextual considerations, and not on semantic facts.

(7) (a) It's possible that John will inherit the house.
(b) There is a possibility that John will inherit the house.

4. Concluding remarks

One thing to notice about the correlation between the emergence of epistemic concepts and theory of mind is that it lends itself to experimental testing. An obvious place to look is autistic subjects' performance with epistemic modality, since it has been persuasively argued that autism involves a deficit in theory of mind abilities (Leslie, 1991; Leslie and Roth, 1993). Some work has been done in this connection, but the results are not always straightforward (de Roeck and Nuyts, 1994). Another possibility is to further investigate the correlation between the development of epistemic modals and mental terms or evidentials. More on the linguistic side, it would be interesting to revisit the widely accepted association between developmental arguments for polysemy and historical-linguistic arguments in a version of the

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'ontogeny recapitulates phylogeny' tenet. Stephany (1979/1986), among others, has explicitly put forth this view with regard to modality in maintaining that developmental progress reiterates diachronic grammaticalization processes: the next step in attempting to investigate the scope of polysemy analyses would be to examine this connection, or its validity for synchronic competence. Tellingly, Stephany concludes her article by stating: 'The priority of deontic, as compared to epistemic, modality in the ontogenesis as well as in the history of languages can be considered as indicating the primacy of the social, as compared to the epistemic, function of language' (Stephany, 1979/1986, p. 400). But that's the story of another paper.

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