The interdependence of modality and Theory of Mind

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THE INTERDEPENDENCE OF MODALITY AND THEORY OF MIND

A Dissertation

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Louisiana State University and
Agricultural and Mechanical College
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by

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For Peter, Jerrad, and Alexander
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Abstract

Modality is traditionally defined as the expression of possibility or necessity. In English, modality is expressed by the modal auxiliaries such as *can, would, should,* or *might*; adjectives and adverbs such as *possible, necessary, maybe,* and *absolutely*; or phrasal verbs such as *going to* or *have to.* Theory of Mind (ToM) is broadly defined as the ability to attribute thoughts and beliefs to other people. ToM is usually expressed using propositional attitude verbs such as *think* as in *Mary thinks that it will rain.*

Hegarty (2006, 2010) proposes that propositional attitude verbs are covertly modalized and can be analyzed using the same apparatus as modals. If this theory is correct, then attitude ascriptions that are used to express ToM should be acquired by children after the child has a command of modality.

Previous research shows that modality emerges in children as young as two years of age (Choi, 1999), but that children do not reach adult proficiency until around twelve years of age (Coates, 1987). Similarly, ToM begins to emerge when children can pass the standard false belief task near their fourth birthday (Wimmer & Perner, 1983; Baron-Cohen, Leslie & Frith, 1985), but children lack the necessary interpretation of the thoughts and beliefs of other people until they are approximately twelve years old (Lalonde & Chandler, 2002).

This study evaluates the acquisition of both modality and ToM in eighty-six first, third, and fifth graders, using elicitation tasks for modality and question-answer tasks to test for higher-order ToM. The data was then analyzed indicating the approximate age of the acquisition of different types of modality such as epistemic (both strong and weak), alethic, priority, and dynamic. These results were then compared to those of the ToM tasks which indicate the age at which first, second, third, and fourth order ToM are acquired. The data suggests that modality
and ToM are interdependent. Based on the results, a strong sense of modality emerges before the appropriate use of expressions of the second-order ToM, and third and fourth order ToM are mastered before the more difficult expressions of modality.
1 Introduction

When two people have a conversation, there is a certain amount of information that must be shared between them. If Speaker A and Speaker B are having a conversation, then Speaker A knows what he, himself, knows and Speaker B knows what she, herself knows. In the intersection of the two sets of knowledge lies what they both know. Both Speaker A and Speaker B believe they know what the other one knows, at least with regard to the current conversation; this is their shared knowledge. This shared knowledge includes what they see in the surrounding environment, the information from any prior interactions that they may have had, as well as all of the information that “everyone” knows, like the norms of their society.

Their shared knowledge is the context of the current conversation. Each utterance in the conversation takes a small bit of what Speaker A knows and adds it to what Speaker B knows, or vice versa, and updates the context. Dynamic semantics interprets an utterance based on the potential of that utterance to update the context of the addressee (Heim, 1982; Kamp, 1981; Groenendijk & Stokhof, 1991). This is known as the Context Update Potential (CUP).

In modality, the epistemic base is the set of worlds in which the speaker’s evidence holds constrained by the speaker’s dispositions (Hegarty 2010). It is presumptively shared by the addressee(s) and the speaker can regard it as normative (Hegarty, 2010). Therefore, the epistemic base is that which the speaker knows and assumes the addressee also knows. This changes and is updated with new information based on the conversation almost constantly. Hence, the context and the epistemic base have the same character (Hegarty, 2010).

Modality is an expression of possibility or necessity or anything in between. Modality has a variety of forces including, but not limited to, certainty (must), likelihood (should), and possibility (might). When a speaker uses an epistemic modal statement such as *It must be*
raining, he or she is stating that according to his or her epistemic modal base, or what he or she
knows, it is a certainty that it is raining. But insofar as the statement *It must be raining* signals
that it is made based on what the speaker knows, or thinks she knows, it can actually be a weaker
or more tentative statement than “It is raining.” This is because in being modal it makes
reference to an epistemic modal base, which makes the possibility of speaker error more salient
than in the non-modal “It is raining.” This statement has the potential to update the addressee’s
context, and therefore the shared context, with a certainty of rain. Modalized Dynamic
Semantics interprets the utterance in terms of context update according to the speaker’s criteria
for updating the context, presumptively shared with the addressee. So, the CUP of S acts on the
context by keeping only those worlds in which the proposition expressed by S is true.

In a third-person ascription, the context is an attributed context, which speaker and
addressee attribute to the referent of the ascription. The ascription states a context update
condition on the attributed context, with a strength determined by the attitude predicate. If
someone *thinks that it is raining*, Modalized Dynamic Semantics can evaluate *it is raining* based
on the context, but still allows for some possibility that the person to whom the belief is ascribed
is incorrect.

In a first person ascription, the attributed context is replaced by the speaker-addressee
context. When a speaker states a belief, such as *I believe it is raining*, he or she is informing the
addressee that the shared speaker-addressee context should be updated by the proposition *it is
raining*. A similar update is encouraged by utterances regarding things that the speaker *thinks*,
and is *certain of*, as well as other propositional attitude verbs. The utterance is evaluated based
on the number of possible worlds in which the subsequent proposition is true. The first person
ascription quantifies over worlds in the speaker-addressee context, stating an update condition on a number of worlds in the context, where that number depends on the attitude predicate.

Theory of Mind (ToM) is the ability of a person to attribute thoughts and beliefs to other people. This is often expressed with propositional attitude verbs: believe, think, etc., such as John thinks Mary is at home. Children begin to acquire the ability to appropriately express the thoughts and beliefs of other people at approximately four years of age, but do not have a full ToM until shortly before their teenage years (Wimmer & Perner, 1983; Lalonde & Chandler, 2002).

Modality is the expression of possibility or necessity or anything in between. This is often expressed with auxiliary verbs such as must, could, would, should, and might, as well as nouns like possibility and probability, and adjectives like possibly and probably. Children begin using modality around the age of three, but do not have a handle on the intricacies of the meaning of modal expressions until they are at least twelve (Coates, 1987).

Because modality and the verbs required to express ToM both delimit the number of worlds in which the proposition they express is true, and they both are first used around the same point in a child’s development, and they are both fully utilized at approximately the same point, this study contends that there is an interdependence between the acquisition of modality and the acquisition of the expressions used for ToM. The following will explicate this interdependence by first evaluating the existing literature, then describing a study used to elicit modality and ToM. Children are tested at three different stages in their development to account for different points in acquisition. The results from the study show that the different types of modality as well as the different stages of ToM are acquired at approximately the same rate, with modality slightly before ToM, supporting the hypothesis that they are interdependent.
2  Literature Review

2.1  Modality

Modality is broadly defined as having to do with necessity and probability. Palmer (1986) defines modality as a grammatical category based on speaker’s attitudes and opinions that is determined cross-linguistically by semantics and pragmatics (or the interface thereof) and Wells (1985) uses the speaker’s assessment of the probability of the state or event in the proposition as his definition.

In English, modality can be expressed by auxiliaries such as *can, will, must, may, should, would, could,* and *might* as in:

(a) I can buy a new car in July.

The insertion of any of the modal auxiliaries in place of *can* in (a) will lend a particular degree of necessity or probability to the proposition. Modality can also be expressed with adjectives, adverbs, and nouns, as in:

(b) It is possible that I will buy a new car in July.

(c) Perhaps I will buy a new car in July.

(d) My buying a new car in July is a possibility.

Similarly, modality can be expressed by suffixes such as *-able,* conditional clauses such as *if...then* phrases, or it may be inherent in verbs such as *need to,* as in:

(e) Buying a car in July is doable.

(f) If I earn enough money, then I will buy a car in July.

(g) I need to buy a car in July.
The possible expressions listed above can exemplify different subtypes of modality including epistemic modality, which deals with the degree of the speaker’s commitment to the truth of the proposition under the modal:

(h) I might buy a car in July.

Deontic modality is concerned with the necessity or possibility of acts performed by morally responsible agents, or with obligation and permission:

(i) I must buy a new car, the emissions are polluting the whole city.

Alethic modality deals with logical necessity or possibility as in:

(j) It is possible for this car not to have existed.

Dynamic modality is when circumstances in the real world make possible or necessary the actualization of a state of affairs.

(k) I can buy a new car in July.

Teleological modality is based on goals.

(l) To get this job, I must buy a new car.

Bouletic modality is concerned with desires or wishes.

(m) I’ve never purchased a new car before, I must have red.

And finally, root modality includes both deontic and dynamic modality.

A review of the recent literature with regard to modality will undeniably go in several directions. While most researchers concentrate primarily on the modal auxiliaries without broadening their investigation to the other possible expressions of possibility and necessity, there tends to be a division in the investigation of modal interpretation. Researchers seem to believe that modal interpretation is either lexically based, where the modal word or phrase is directly responsible for the degree of possibility in the proposition; a matter of compositional semantics,
where the meaning is determined by the combination of the constituents in the proposition; a matter of inference based on context, or any combination thereof.

2.1.1 Lexical Analysis

If modality receives a lexically based interpretation, then the modal itself is responsible for the necessity or possibility offered in the proposition. Due to the range of interpretations available for each modal, the words themselves must be either ambiguous, having more than one meaning, or polysemous, having two (or more) senses of a word which have related meanings. Researchers who believe that modality is lexically based primarily concentrate on the grouping of modal auxiliaries into the different subtypes in an effort to explicate the meaning.

Jennifer Coates, in 1983, splits the modals into two groups, root and epistemic. First, epistemic is defined as concerned with the speaker’s assumptions or assessment of possibilities. Epistemic modals indicate the speaker’s confidence or lack of confidence in the truth of the proposition expressed or in the evidential status of the proposition. On the other hand, she claims that root modality varies in terms of subjectivity and in terms of a strong-weak continuum. Coates considers root modality anything that is not epistemic. Gradience is an essential feature of root modality and root can be distinguished from epistemic by the syntactic patterns that are associated with the modals.

For Coates, animate subjects, agentive verbs, and passive voice are all associated with root meanings. This categorization is fundamentally incorrect. Epistemic modals can have animate subjects, agentive verbs, and be used in passive constructions, as in (1-3) respectively:

(1) I can’t find the ring where he claimed it is. He may have been mistaken.

(2) The waiter doesn’t seem interested in us; Max may have paid already.
(3) (Viewing a bloody crime scene with no body in view) A murder may have been committed here.

It is noteworthy that Coates recognizes that other linguists use other categorizations of modals including deontic, dynamic, and existential. She believes that breaking the modals into so many groups fails to capture that all of the non-epistemics can be shown to lie in a cline ranging from strong to weak, in the same way as epistemics lie in a cline from confident to doubtful. She also notes that multiple groups require that the investigator draw “imaginary lines” choosing arbitrary cut-off points. Interestingly, it seems as though Coates herself draws a line between root and epistemic which is not borne out by the data, as discussed above.

Butler (2002) also finds two main groups of modality, root and epistemic, although he finds it necessary to have two subgroups of each. Recognizing that each branch of linguistics will break the modals up differently, Butler requires a necessity and possibility classification for both root and epistemic. He is left with a four-way split, which he uses as the basis for his desiderata for a theory of modals. For Butler, a good theory of modals accounts for four topics. First, it will deal with the four-way split with at most two features dealing with each other at a time. This leaves epistemic necessity, epistemic possibility, root necessity, and root possibility. Butler argues that this will reduce duplication among the entries in modal categories. The second requirement is that a theory of modals decides in which part of the grammar modality splits up: the lexicon, syntax, the semantic/pragmatic process, or a combination. The third requirement is, of course, why the grammar splits modality in this fashion. Finally, a theory of modality must account for different languages using the same word (within that language) or sentence to represent both epistemic and root senses. For example, must in (4) exhibits the epistemic sense in (a) and root in (b) (Butler’s examples (5) and (7)):
(4) You must be an ambassador to England or France.

(a) It is a necessary assumption that you are an ambassador to England or France.

(b) You are required to be an ambassador to England or France.

Fortunately, it is not necessary to depend on Butler’s categorization to agree with the major points in his desiderata for a theory of modality. He is correct in requiring that a theory of modality define exactly what modality is and how it is interpreted. Whether or not it is necessary to categorize modals the way Butler has is left to be determined.

Finally, Narrog (2005) categorizes modals differently from everyone else so far. He begins with epistemic, which to him means that the proposition is underdetermined with respect to its factuality relative to the world of knowledge and beliefs of the speaker. His second category of modals is evidentiality, which occurs when the proposition is underdetermined relative to sources of information other than the speaker. For example, *He allegedly died in a car accident.* represents evidentiality. The information, or lack thereof, comes from a news report or some other entity. Narrog’s third and final modal category is agent-oriented which includes what would traditionally be deontic and dynamic modality.

Against the lexically-based interpretation of modality, Papafragou (1998) argues that the categories that have been assigned to capture the full range of meanings in natural language do not correspond to the distinct senses for the modals. To compensate for this shortcoming, many authors introduce new labels or write off the individual meanings of the modals as conventions of usage or pragmatic extensions. She believes that descriptive adequacy is achieved at the expense of an explanatory account of the semantics and pragmatics of the modals.

Papafragou (1998) explains each of the views regarding the categorization for modals, then notes the difficulties with each view. Dealing with the ambiguity view first, Papafragou
states that “the categories introduced by the ambiguity view do not really correspond to distinct senses for the modals, among which it is always possible to choose” (1998, 3-4). Given the sentence:

(5) You can be the first person to join our forces at such a young age.

It is difficult, if not impossible, to distinguish between dynamic *can*, which would give the reading that it is possible given the state of affairs in the world for you to join our forces, and deontic *can* where the speaker gives permission to join our forces. This explains why it is difficult, when choosing the ambiguity view, to maintain consistency in categorizing modals.

Papafragou (1998) goes on with a second argument against the ambiguity view noticing that the meanings are incorporated either by introducing semantic labels for an already “overloaded” semantic component, or “hiving them off to ‘conventions of usage’ or ‘pragmatic extensions’” (4). If *must* conveys epistemic necessity (*You must be joking.*), deontic necessity (*We must leave immediately.*), and dynamic necessity (*John must go if he wants to catch the bus.*), then which of those accounts for the normal interpretation of:

(6) You must come to dinner sometime.

which is something akin to:

(7) We would like for you to come to dinner sometime.

If the ambiguity view were employed, *must* in (2) would be forced into the deontic category, requirement by law, rule, or social convention, and then softened by pragmatic extension or a convention of usage.

Papafragou (1998) argues that the ambiguity view does nothing more than skirt the issue of a completely descriptive account of the modals. Many researchers choose different groups, then place the modals (usually modal auxiliaries) into the chosen categories. This manner of viewing
modals seems to force the modals somewhere, whether they necessarily belong there or not. The researchers, then, tend to make generalizations about the categories. This method, in addition to seeming strained, makes it terribly difficult to deal with the adjectival, adverbial, or phrasal modals.

The polysemy view metaphorically extends the notions of modals into the internal, mental domain thereby allowing for the same word to have different senses with related meanings. A metaphorical extension of epistemic *may* gives the denotation of “barriers or forces operating in the domain of reasoning” (Papafragou 1998, p.6). This metaphorical extension is exemplified in the paraphrase of (8) and (10) in (9) and (11):

(8) The butler may have committed the murder.

(9) I am not barred by my premises from the conclusion that the butler has committed the murder.

(10) You may spend this sum any way you wish.

(11) You are not barred by any authority from spending this sum any way you wish.

It then becomes the task of pragmatic interpretation processes to determine which of the subtypes is intended.

While the polysemy approach supplies a motivation for the relation between the different subtypes of modals, Papafragou criticizes the polysemy view with many of the same arguments as her critique of the ambiguity approach, and believes that a more explicit approach is necessary. According to Papfragou (1998), the polysemy approach is constrained by the fact that not all modals have uses in each subtype. *Can*, for example, is not normally used epistemically. She concedes, however, that “a single semantics for the modals could leave room for a pragmatic explanation of the gaps in their distribution” (7).
2.1.2 Compositional Semantics Approach

Instead of lamenting about the categories that delimit modals, another option is to study the modals themselves and their interaction with the proposition. Compositional semantics is the principle that the meaning of a complex expression is determined by the meanings of its constituent expressions and the rules used to combine them. Modals combine with the other words in the proposition to create a meaning. Because it seemed as though each modal could appear in multiple categories depending on its context, in 1977, Kratzer began her quest with modals with the idea that a semantic description should capture the common kernel of meaning even though the meanings vary depending on use. She contends that there is a neutral meaning of each verb. Kratzer continues with the argument that modals have an argument structure similar to that of verbs. Each modal requires two arguments, the first is “in view of”, possibly provided by the context rather than explicitly, and the second argument is provided by the meaning of the proposition. She analyzes must and can specifically and takes the reader through the argument itself and then some objections. Using a possible worlds semantics, Kratzer (1977) outlines several definitions which are central to her argument. After defining the variables, Kratzer lands on her first complete definition of must (Kratzer’s (5), 346):

The meaning of ‘must in view of’ is that function \( \zeta \), which fulfils the following conditions:
(i) If \( p \) is a proposition and \( f \) a function which assigns a set of propositions to every world \( w \in W \), then \((f, p)\) is in the domain of \( \zeta \).
(ii) For any \( f \) and \( p \) such that \((f, p)\) is in the domain of \( \zeta \), \( \zeta(f, p) \) is that proposition which is true in exactly those \( w \in W \) for which the following holds: \( p \) follows (logically) from \( f(w) \).

This definition is unacceptable because it is theoretically possible that both \( p \) and \( \neg p \) can following logically from \( f(w) \). Kratzer gives an imaginary example where the law in New Zealand is comprised of judgments that are handed down, all of equal weight. If one judgment is
handed down that declares that murder is a crime and another that declares murder not to be a crime, then it logically follows in view of what New Zealand judgments provide that murder both is and is not a crime.

In order to eliminate the contradiction, Kratzer adds to her definition consistency, sets, and subsets as follows (351):

The meaning of ‘must in view of’ is that function ζ which fulfils the following conditions:
(i) If $p$ is a proposition and $f$ a function which assigns a set of propositions to every world $w \in W$, then $(f, p)$ is in the domain of $ζ$.
(ii) For any $f$ and $p$ such that $(f, p)$ is in the domain of $ζ$, $ζ(f, p)$ is that proposition which is true in exactly those $w \in W$ for which the following holds: if $X$ is the set of all consistent subsets of $f(w)$, then there is for every set in $X$ a superset in $X$ from which $p$ follows (logically).

The idea that all non-consistent subsets are removed solves the contradiction problem and Kratzer is left with a definition of must which can withstand the different instances of use while maintaining the kernel meaning.

Kratzer goes through the same process with can, beginning with a broad definition and refining it to a more all-encompassing working definition (352):

The meaning of ‘can in view of’ is that function which fulfils the following conditions:
(i) If $p$ is a proposition and $f$ a function which assigns a set of propositions to every world $w \in W$, then $(f, p)$ is in the domain of $χ$.
(ii) For any $f$ and $p$ such that $(f, p)$ is in the domain of $χ$, $χ(f, p)$ is that proposition which is true in exactly those $w \in W$ for which the following holds: if $X$ is the set of all consistent subsets of $f(w)$, then there is a set in $X$ such that $p$ is (logically) compatible with all its supersets in $X$. 
Kratzer (1977) now has an account of *must* and *can* in terms of logical consequence and probability. The question remains, however, whether or not these definitions can be applied to all modal auxiliaries and furthermore, to all instances of modality.

In 1981, Kratzer furthers her account of conversational backgrounds by analyzing modality in German. She also gives explicit definitions for the truth of a proposition, logical consequence, consistency, logical compatibility and the like (1981, p.42-43), all of which help clarify her 1977 definitions of *must* and *can*. Furthering her investigation of modality, Kratzer sets the parameters for modals. The first consideration is the modal relation which includes the notions of simple necessity and simple possibility. Then, her “what is known” argument, or the conversational background, is a function which assigns sets of propositions to possible worlds. For example, an epistemic conversational background is the “function from W into the power set of the power set of W, which assigns to any world w of W the set of all those propositions which are known in w” (43). She lists and gives the definition of conversational backgrounds such as realistic, totally realistic, epistemic, stereotypical, deontic, etc. Finally, the ordering source delimits the number of possible worlds that are available, excluding those that are so far-fetched as to be completely unlikely, given the conversational background.

With these parameters in mind, Kratzer (1981) examines the modal relation of human necessity as (47-48):

A proposition p is a human necessity in a world w with respect to a modal base f and an ordering source g iff the following condition is fulfilled:

For all u ∈ f(w) there is a v ∈ f(w) such that
(i) v ≤ g(w) u
and
(ii) for all z ∈ f(w): if z ≤ g(w)v, then z ∈ p

The accessible worlds are determined by the modal base and the ideal is provided by the ordering source.
As in her 1977 argument, the parameters are not necessarily explicitly stated as they are often determined from context or assumed by both the speaker and hearer. This is where the possibility of misinterpretation arises. A person who has a complete grasp of modality has the ability to categorize conversational backgrounds according to the rules designated by the vocabulary. Such a person then has the ability to draw inferences based on the modal base and the ordering source.

In 1991, Kratzer furthers her 1981 argument by showing how the previous modal logic, what she calls the standard analysis, fails to account for inconsistencies in sets of propositions, and thereby yields contradictions. The standard analysis does not have the capacity to deal with graded notions of possibility or necessity because the standard analysis requires that a proposition either is or is not compatible with a set of propositions. There is not an option for more or less compatible, or barely compatible, or similar conditions. Kratzer takes her definitions from her 1981 argument and defines a set of modal notions to account for this range of possibility and necessity. In doing so, she incorporates the gradable notions of modality. Adding to the definition of human necessity above, Kratzer (1991) now includes possibility and other gradients of necessity as in (644):

\[
\text{A proposition } p \text{ is a possibility in a world } w \text{ with respect to a modal base } f \text{ and an ordering source } g \text{ iff } -p \text{ is not a necessity in } w \text{ with respect to } f \text{ and } g.
\]

Modal interpretation depends on two parameters rather than just one, or is doubly-reflexive. With this new apparatus with which to analyze modality, we can now account for the different gradations and inconsistencies of natural language. Speakers can now distinguish between a bare possibility from a more robust possibility in a given conversational background, using the ordering source.
To look at epistemic modal interaction with other quantifiers, Kai von Fintel and Sabine Iatridou (2003) choose constraint-based approach within formal semantics. They begin with a constraint on the scopal interaction of quantifiers with epistemic modals, which they call the Epistemic Containment Principle (ECP):

A quantifier cannot have scope over an epistemic modal (174).

They are careful to remind the reader that there is an emphasis on epistemic modals, that deontic or other modals play no part in the discussion.

There are two types of evidence for the ECP: scope judgments and binding impossibilities. Quantifiers show scope ambiguities with deontic modal operators, as in the ambiguous (von Fintel and Iatridou’s (4) p. 175):

(12) Most of our students must get outside funding -

a. for the department budget to work out.

b. the others have already been given university fellowships.

According to von Fintel and Iatridou, in the first continuation, most of our students takes scope under the deontic modal must; therefore, the interpretation is in order for the budget to work, it needs to be the case that most of the students get outside funding. The second continuation puts most of our students over the modal because the obligation is imposed upon the students who have not already been given fellowships. This ambiguity does not hold true with epistemic modals. In fact, epistemic modals must take scope over a quantifier, as in:

(13) Most of our students must be home by now.

where must takes scope over the quantified nominal most of our students in order to maintain the epistemic reading. However, it is difficult to determine the relative scope of most and epistemic must in the above example (175).
Further evidence that there is no scope ambiguity when one of the quantifiers is an epistemic modal is provided by (14) (von Fintel and Iatridou’s (9), p.176):

(14) # Every student may be the tallest person in the department.

The possibility exists for each student that he or she may be the tallest in the department, but it is logically impossible that every student be the tallest in the department. The ECP requires the modal in (14) to take wide scope, but the resulting interpretation, that it may be the case that every student is the tallest, is impossible. The sensible interpretation, that every student, so far as we know, may have the property of being the tallest, requires the quantifier to take wide scope over the modal and is, therefore, not permitted by the ECP. So, (14) shows that every student cannot have scope over epistemic may.

In their explanation of the binding impossibilities that the ECP exemplifies, von Fintel and Iatridou (2003) remind the reader that quantifiers can only bind variables in their c-command domain. Given the sentence:

(15) Every student must be awake if his light is on.

with the intended reading that each student, whose light is on, must be awake, the pronoun remains unbound. In order for every student to bind his, every student must have scope over the entire sentence, and this is forbidden by the ECP. Therefore, the pronoun his remains unbound and the ECP predicts that there is no reading where the pronoun is bound. Therefore (16) is interpreted just as easily:

(16) Every student must be awake if Joe’s light is on.

The ECP is considered in two ways: (a) as an intervention effect blocking quantifier-variable relations, and (b) as a reflection of the strict ordering of projections in the topology of
clauses (179). However, von Fintel and Iatridou explain that epistemic modals do allow binding of variables across them, as in the perfectly interpretable (179):

(16) Every student thinks that Mary may/must like him the most.

Similarly, a wh-phrase can bind its trace across an epistemic modal, as in (180):

(17) Who must she have hired for that job?

With these examples in mind, von Fintel and Iatridou conclude that the ECP must be stated as a condition that is only about the relationship between quantifiers and their traces at LF, thereby prohibiting LF raising of a quantifier across an epistemic modal and forcing quantifiers that have raised to take scope back under the modal. They, therefore, revise the original definition of the ECP (181):

At LF, a quantifier cannot bind its trace across an epistemic modal.

This is compatible with the view that the ECP is a result of the hierarchical structure of the clause. Von Fintel and Iatridou combine the ideas that epistemic modality is located very high in the clause (Cinque 1999) and that quantifier movement targets particular positions in the sentence (Beghelli and Stowell 1997) to explain the ECP effects for monoclausal cases. Never do they explain, however, why epistemic modals are so high, or why epistemic modals would be higher than other types of modals.

Von Fintel and Iatridou (2005) also propose the Sufficiency Modal Construction (SMC) which addresses the modality of constructions containing only and have to in sentences such as

*To get good cheese you only have to go to the North End.* This construction is interesting because the necessity modal have to together with only or a negation and an exceptive phrase yield the reading that going to the North End is a way of finding good cheese and going to the
North End is relatively easy. This construction does not claim that the only good way to get good cheese is to go to the North End.

The SMC is found in three environments:

1. in constructions with a purpose clause
   = To get good cheese you only have to go to the North End.
2. anankastic conditionals
   = If you want good cheese you only have to go to the North End.
3. causal conjunctions
   = You only have to go to the North End and you will find good cheese. (66)

Using Kratzer’s terminology as discussed above, von Fintel and Iatridou employ a possible worlds semantics in their discussion of the SMC. The modal base is given by the interplay of the necessity modal and the infinitival purpose clause. The worlds where the facts are the same as those in the actual worlds are those that are quantified over and are restricted by the purpose clause. In other words, going to the North End is a sufficient condition for finding good cheese.

One of the requirements for the SMC is that the modal in question have universal force. Yet, not all universals work appropriately. For example:

(18) * If you want good cheese you (only) must (only) go to the North End.

(19) * If you want good cheese you (only) should (only) go to the North End.

To delimit the universal modals, von Fintel and Iatridou investigate the scoping properties with respect to negation. They find that the modals that scope under negation work in the SMC, the ones that cannot appear in the SMC scope over negation. For example, negation scope over the modal (69-70) which works in the SMC:

(20) He doesn’t have to go there. NEG › modal

(21) He need not do that. NEG › modal.

and modal scope over the negative (70) which does not work in the SMC:

(22) You should not leave. modal › NEG
(23) *He must not be there now.* modal › NEG

Next, von Fintel and Iatridou look at the exceptive marker (*only* or neg + exceptive) as one of the characteristic ingredients of the SMC. They find that *only* has two components. For example, the *only* in *Only John was in the room.* asserts that nobody other than John was in the room and presupposes that John was in the room (Horn, 1969). They consider *John was in the room* the prejacent and *only* acts on the prejacent by signaling an assertion and a presupposition. In the SMC, the truth of the prejacent is not automatically assumed to be true. The sentence *To find good cheese you only have to go to the North End.* correctly asserts that you do not have to go to Milan or Rome to find good cheese, but it presupposes that to find good cheese you have to go to the North End. Therein lies the problem. There is nothing about that sentence that requires you to go to the North End for cheese; it does not imply that the only place you can find good cheese is in the North End. In this instance, the prejacent cannot be inferred.

The solution to this problem is proposed to contain three elements: negation (NEG) scoping over a necessity modal which in turn scopes over an exceptive quantifier (77). First they weaken the presupposition, so instead of going to the North End, the presupposition is now that you have to do something. Now they are left with the presupposition that you have to do something and the assertion that it is not the case that in all of the worlds you do something other than go to the North End. The SMC is now split into three different operators: NEG › necessity › “something other than”. They get this by splitting *only* into NEG and “something other than”, so *only* in *To find good cheese you only have to go to the North End.* is equivalent to *there is nothing you do other than go to the North End.*, then they split its scope across the universal modal. Splitting *only* into NEG and “something other than” in the SMC is necessary because
von Fintel and Iatridou (2005) assume that the necessity modal has logical scope between negation and the existential exceptive phrase (85).

The final requirement for the SMC is *easiness*. The SMC does not entail, but implies that the action required (go to the North End) is relatively easy, or at least as easy as any other way to get good cheese. In other words, you do not have to do anything more than to go to the North End to get good cheese. In this context, von Fintel and Iatridou have begun an investigation of different modal interpretations.

### 2.1.3 Inference

Because modals are context-dependent expressions in that their linguistic semantics “radically underdetermines the overall meaning they communicate” (11), Papafragou (1998) offers her own semantics for modals. She develops the notion of domains of propositions. Similar to the tripartite structure of quantificational devices in natural language, she assumes that the semantic content of modals consists of two components: a logical relation $R$ and a domain $D$ of propositions.

$$R(D, p)$$

Accordingly, it is the restrictor, $D$, that is responsible for the different types of modal concepts which a modal expression is capable of expressing in different contexts.

Papafragou (1998) proposes that propositions come with a built in index which signifies the domain to which they belong. Her theory is based on the idea that any given proposition can be entertained and stored in memory in several different ways. She includes domains such as factual assumptions, the means by which we represent reality to ourselves; regulatory, more constrained systems of laws, regulations, and rules; descriptions in states of affairs in ideal worlds; descriptions of states of affairs in worlds desirable from another’s point of view; and
abstract representations (12-13). Papafragou considers this group of domains neither exhaustive nor mutually exclusive, but useful particularly when comparing modals in different languages or for tracing historical developments.

With the domains established, Papfragou (1998) proposes a semantics for *may*, *can*, *must*, and *should*, as follows (14):

- **May**: p is compatible with the set of all propositions in domain D
  (D-value → unspecified)
- **Can**: p is compatible with the set of all propositions in domain D
  (D-value → factual)
- **Must**: p is entailed by the set of all propositions in domain D
  (D-value → unspecified)
- **Should**: p is entailed by the set of all propositions in domain D
  (D-value → normative)

The domains of *may* and *must* are “examples of pragmatic saturation of an unspecified semantics” (14) and therefore are free of restrictions on the domains. *Can* and *should*, however, are examples of “free pragmatic enrichment of an already complete, albeit vague, semantic content” (14). Papafragou gives *should* a “normative” or deontic domain which entails that occurrences of *should* relate to a moral ideal or standard, as in:

(24) Children should eat vegetables.

where it is children’s moral obligation to eat vegetables. *Should*, however, is not necessarily normative, but can also be epistemic, as in:

(25) John should be in his room.

in the context of John should be in his room because his light is on and he rarely leaves his room without turning off his light. Given all of the relevant information, it is very likely that John is in his room.

Papafragou (1998) uses this restriction on the value of domains in order to limit the conceptual search space. While this would seem beneficial to the processing of each modal, the
examples given in (24) and (25) show that the search space necessarily includes all of the possible occurrences of the modal.

The unfortunate consequence of Papafragou’s analysis of modal domains is that if *must*, for example, has an unspecified domain, it becomes immediately necessary when used in context to specify the set of propositions with which it is compatible; in other words, to specify a domain. She does just that by giving multiple contexts for *must, can, should,* and *may* and then describes, for example, deontic *must* (25):

(i) the modal restrictor involves a set based on the speaker’s desires and factual assumptions (or, alternatively, a set of regulatory propositions which the speaker is entitled to enforce);
(ii) the speaker has authority over the hearer;
(iii) the hearer is in a position to bring about the state of affairs described in the embedded proposition

Identifying the domains and setting up a tripartite structure for modals is inconsequential if, afterwards, it is still necessary to denote the meaning based on categories such as epistemic, deontic, and alethic. Papafragou (1998) disagrees with Kratzer’s theory because “the possible worlds model is not meant as a psychologically plausible model of how speaker’s represent and handle alternative possibilities” (9) and is hard to reconcile with experimental findings. In her discussion, she suggests that Kratzer allows for too many options of possible worlds for the hearer and the hearer could not possibly process more than just a few options. However, leaving the domain unspecified seems to leave the listener with a multitude of possible options, until of course, the context is added. It seems as though Papfragou and Kratzer achieve the same goal using different apparatus. Both authors limit the number of possibilities of meaning of a modal,
Papafragou with her domain and context and Kratzer with her conversational background and ordering source.

The above summaries and highlights are nothing more than a mere glimpse into the enormous amount of literature that is available on the subject of modality. The lexically based approach, while important in terms of understanding the possible interpretations for each modal, leaves quite a bit to be desired when the modal is considered in context. The compositional approach takes into account the context of modals as well as their co-occurrence with several other structures. The inference based approach considers modality in context while accounting for pragmatics.

It is nearly impossible to consider the meaning of a word or group of words without a context. This study, therefore, uses a combination of the above accounts, taking pieces from each of the above theories to account for children’s production of modality given a particular environment.

2.1.4 Modality in Children

Previous studies have provided evidence for the early acquisition of the semantic properties of modal auxiliaries in normally developing children (Coates, 1987; Hirst & Weil, 1982; Noveck, Ho, & Sera, 1995; Choi, 1991; Leonard, et al., 2007). There is a large variance with regard to the age of modal acquisition, which according to the above-mentioned studies can be anywhere between 2;6 and 12;0, depending on the type of modality acquired. Most of the previous studies surround only the modal auxiliaries in English rather than modality in general. Previous studies also tend to concentrate on epistemic modality alone or in relation to deontic modality rather than include other types. While there are few studies to begin with, the limited focus leaves a wide range of the acquisition of modality largely understudied.
In an effort to determine the extent to which children can identify the differences in force with *must, should,* and *may,* Hirst and Weil (1982) developed a study in which children were asked to choose the most probable or permissible of two modal propositions. Using both an epistemic task and a deontic task, children were asked to locate an item based on the examiner’s sentence. The children were divided into seven groups (A-G) with a mean ages of 3;4, 3;8, 4;4, 4;10, 5;5, 5;11, and 6;5 respectively. In each task, the children were given both an epistemic and a deontic task. For the epistemic task, each child was seated at a table, and on the table were a cup and a box. They were told that the experimenter would hide a peanut under the cup or the box and the puppets would tell them where it was. They were to listen to the puppets and try to find the peanut. The child was given two clues by the puppets, similar to *The peanut should be under the cup,* and *The peanut may be under the cup.* The child was said to appreciate that one proposition is stronger than another if he or she found the hidden peanut for both instances of the contrast. If fifty percent or more of each group correctly located the peanut, the group was said to appreciate the contrast between modals.

The deontic task was structured similarly to the epistemic task. Two model rooms were put on the table, one green and one red. The children were introduced to a doll named Andy, and two puppets, who were Andy’s teachers. The children were told that Andy could play in either the red room or the green room. One teacher would say *You X go to the green (red) room,* while the other stated *You Y go to the green (red) room,* where X and Y were the modal contrasts *must/should, must/may,* and *should/may.* The children were asked where Andy would go if he were a good boy based on the teachers’ sentences.

Hirst and Weil (1982) draw several conclusions from their experiment. Modals are distinguished from factuals, *may* is distinguished from *is,* before any appreciation for the strength
of modals develops. They also found that “differentiation within the modal field also proceeds in an orderly fashion (665). From the child’s choices and frequency of correctness, the examiners found an appreciation of force between is, may, must, and should. Hirst and Weil (1982) determine that children first appreciate the difference between must and may, then should and may, and finally must and should. From this experiment, Hirst and Weil (1982) conclude that the greater the difference in the strength of the two modal propositions the earlier the children can appreciate the difference. They also conclude that it is unlikely that the two senses of modals (epistemic and deontic) develop independently, but that both readings are derived from an underlying interpretation based on strength or probability. As strictly a comprehension task, the evidence indicates that the children do not find a significant difference in appreciating the force between epistemic and deontic modals, although they do note that it seems as though comprehension of deontic modals lagged behind comprehension of epistemic modals.

Concentrating on epistemic modals, Noveck, Ho, and Sera (1996) duplicated Hirst and Weil’s hidden-object task on five year olds, seven year olds, nine year olds and adults, with only minor modifications. Their first task included one true and one false modal statement using is, has to, and might. Half of the statements presented a relatively weaker sounding modal (might) in the true statements and the other half presented equally forceful modals (has to) in both the true and the false statements. None of the age groups selected a false stronger sounding statement over a true weaker sounding statement. In other words, the participants all considered a statement’s truth value over the strength of the modal. The second experiment contrasted the same modals, but in a context in which only one was logically correct. For example, the participants were presented a contrast in which might correctly described a deducible conclusion and has to did not. While the five year olds’ rate of correct responses was over that of chance,
the seven year olds demonstrated a mature logical understanding comparable to that of the adults. From this experiment they concluded that the relative force of a modal becomes muted for five-year-old children when a situation requires a logical interpretation. Five-year-old children seem to have only a rudimentary understanding of the logical meaning of modals. Noveck, Ho, and Sera (1996) also conclude that success on this task depends on the ability to determine which of the statements is logically true rather than on the force of the modals. Signs of this logical understanding seem to appear around the age of seven, although the “building blocks for logical appreciation of modals” (642) are present earlier.

In 1987, Coates argues that a true picture of a child’s semantic system is unavailable when, at around age 5, the child is considered linguistically competent. She tested two groups of children, ages 8 and 12, and a group of adults as to how modals can be grouped in terms of shared meaning. Giving the children modals in the context of *I X visit my grandmother tomorrow*, where X is a modal, she asked them to place the modals into groups of shared or nearly shared meaning. The adults divided the modals into four distinct groups: epistemic possibility (*may, might, perhaps, possible that, probably*), possibility/ability/permission (*can, could, allowed, able*), intention/prediction/futurity (*will, shall, intend*), and obligation/necessity (*must, should, ought*). The 12 year olds were more similar to the adults than the 8 year olds who had fewer, broader groups. The 8 year olds ended with two large groups with multiple subgroups within them. The 8 year olds rarely agreed with each other regarding the groups into which the modals should be placed. The adults and the 12 years olds were much more consistent regarding the placing of modals into groups. These results led Coates to conclude that an advanced interpretation of modals, and therefore semantic competence, is not obtained until after age 12. The information obtained from this study provides further evidence that children’s
appreciation of the distinctive qualities of modals becomes refined as they grow older, as concluded by Hirst and Weil (1981). While this comprehension task shows that there are groups of modals, it also shows that the groups are broad and the boundaries between groups are variable.

Soonja Choi, in 1991, observed three children between the ages of 1;8 and 2;11 to investigate the spontaneous production of epistemic sentence-ending suffixes in Korean. She chose Korean because modality, in Korean, is expressed by an obligatory class of verbal inflections and because distinctions are made between epistemic and deontic meanings by those inflections. She chose that age range because, in English, children begin expressing “quasi-modals” shortly after their second birthday. Choi’s (1991) observations ranged from seven to fourteen months. She found that the children productively used eleven sentence-ending forms. Choi (1991) found that degrees of epistemic modality develop in four consecutive phases regardless of caregiver input: new/unassimilated information closely related to the present, information that has been assimilated into the child’s knowledge system, certainty of information which has been previously discussed, and finally information that has been indirectly experienced. Because each of the suffixes was used systematically by the children, and the order of acquisition did not correlate with the input frequency, Choi (1991) determines that “the acquisition of these suffixes is the result of an interaction between the child’s cognitive development and the language-specific input” (118). Finally, Choi’s (1991) analysis shows that Korean children make epistemic distinctions before deontic distinctions such as desire and intention. This final determination may depend on the degree of grammatical encoding for the modals in the language as these results vary from those of other researchers, so Choi (1991) chooses to leave the epistemic/deontic distinction for future study.
Leonard, Deevy, Wong, Stokes, and Fletcher (2007) study the modal auxiliaries in grade school children with Specific Language Impairment (SLI) in order to further understand the traditionally weak area of grammatical morphology. This study is of importance here less because of the results, but more because it is a study that uses modal elicitation tasks rather than spontaneous speech or comprehension tasks. Unfortunately, Leonard, et al. (2007) only attempt to elicit modal *can* in both ability and permission contexts.

The ability *can* task consisted of a puppet show consisting of the following enactment:

A police officer walks onto the stage and hears a cat crying for help. The cat is in a tree. A ladder is lying on the ground next to the tree. Ken (one of the puppets) says, ‘Oh, the police officer wants to help get the kitty down. But I don’t think he can get up that high to save the kitty. (turning to the child) What do you think? (214)

The target response is *He can use the ladder*. The fundamental flaw in this task is the experimenter’s use of modal *can* in his/her description of the scene, which prompts the participant not only for the modal *can*, but also for the ability modal *can*. The authors dismiss the use of *can* in the prompt because “an appropriate response would require the child’s use of *can* in a sentence that differed from the one provided by the experimenter” (214). A similar situation arises in the permission *can* task.

The basis of Leonard et al.’s (2007) experiment prompted the first modality task of this study. However, the experiment in this study took precautions not to prompt the participants with any uses of modality or anything that may be perceived as modality in the creation of not only the first task, but also all subsequent tasks.
From the literature on modality in children, it is expected that children begin to produce modality and use it in appropriate contexts as young as two years old (Choi, 1999). Around seven years old, children begin to develop understand the logical meaning of modals (Noveck, Ho & Sera, 1996), and around their twelfth birthday, children begin to appreciate modality in similar ways to adults. Each of the above studies has concentrated on epistemic or deontic modality, leaving the other types (bouletic, teleological, alethic, etc.) understudied with regard to children.

2.2 Theory of Mind

When a child develops the ability to understand that other people may have thoughts, feelings, and intentions that differ from his or her own, when he or she recognizes that thoughts are thoughts that may not be shared with others, when he or she uses societal norms to interpret or predict another’s behavior, or when he or she begins to pretend, deceive, or use sarcasm, a child is said to have Theory of Mind (ToM). ToM is, simply, the ability to impute mental states on oneself and others. While the definition seems simple enough, the development of ToM is an enormous feat for a child. It is around four years of age that children develop this metacognitive ability. The literature surrounding ToM splits into several directions, namely false belief tasks and other such evaluative procedures, the language of ToM, and ToM together with varying aspects of social cognition. For the purposes of the current study, a review of false belief, ToM and its relationship with language, and tasks associated with higher orders of ToM is essential.

2.2.1 False Belief

The most common test for ToM in children in called the false belief task. This task originated with Wimmer and Perner (1983), who intended to test children’s ability to recognize that another person may have an incorrect belief. Their false belief task consists of a story about
a boy named Maxi who places a piece of chocolate into a cupboard and then leaves the scene. In his absence, Maxi’s mother moves the chocolate from one cupboard to another. The subject is then asked to indicate where Maxi will look for the chocolate when he returns. When the subject can represent Maxi’s wrong belief, that the chocolate is in the original cupboard, rather than what the subject knows to be the case, the subject is said to have passed the false belief test. Wimmer and Perner (1983) call this the Standard Displacement task.

The first task conducted by Wimmer and Perner (1983) includes a story in which Maxi intends to deceive his older brother, who is also looking for the chocolate, by telling him the wrong location. This is the competitive version of the false belief task. Another story in their first task places the chocolate too high for Maxi to reach, so he needs his grandfather’s assistance. In this case, Maxi wants to give the correct location of the chocolate. This is the cooperative version. A similar set of stories had essentially the same structure but was set in a kindergarten class with a little girl and a book.

Wimmer and Perner (1983) administered their first set of tasks to 12 4-5 year olds, 12 6-7 year olds, and 12 8-9 year olds. Each child was told two stories, one about Maxi and one about the little girl and her book. The cooperative version was told to approximately half of the participants, and the competitive version was told to the other half. The children were asked to point to the location when answering the question. Wimmer and Perner (1983) found that only four (33%) of the 4-5 year olds answered correctly for both stories in the first task. However, eleven (92%) of the 6-7 year olds and eleven (92%) of the 8-9 year olds correctly answered both stories. It is unfortunate that Wimmer and Perner (1983) conflated the cooperative version and the competitive version into one task. The competitive version, where Maxi is supposed to try to
deceive his brother, adds a number of confounding factors to the task including the participant’s willingness, or lack thereof, to deceive another person.

In addition to the Standard Displacement task as described above, Wimmer and Perner (1983) also include a Stop-and-Think Displacement task in which the researcher asks the participant to stop and think about where Maxi originally placed the chocolate before he or she answers the question about where maxi will look upon his return. They also add another task in which, while Maxi is out of the room, Maxi’s mother grates the chocolate into a cake before she leaves. Wimmer and Perner (1983) call this the Disappear version of the false belief. These tasks were administered to a different group of children. This time there were a total of ninety-two participants, 20 3-4 year olds, 42 4-5 year olds, and 30 5-6 year olds. Not only were there more participants in the second task, but they were also younger. Wimmer and Perner (1983) added a memory question which asked where the chocolate really was after a correct answer to the task question. They also modified the prompt question, changing it to, “What will Maxi do?”, or the equivalent in the book story. Rather than give each child each task, Wimmer and Perner (1983) split the groups of children, giving ten 3-4 year olds the Stop-and-Think task and ten 3-4 year olds the Disappear task. The researchers split each age group, but added a third division (Standard Displacement) for the 4-5 and 5-6 year olds. Each child was told one story about Maxi and his chocolate and one story about the little girl and her book.

None of the 3-4 year olds gave correct answers to both of the stories in the second set of tasks. Of the 4-5 year olds, 6 (43%) correctly answered the question under the standard displacement task, 4 (29%) correctly answered the stop-and-think, and 11 (79%) correctly answered the task involving the disappear condition. Wimmer and Perner suggest that this is evidence that around the age of four years old, children can successfully pass the false belief task
and therefore have ToM. Again, it is unclear whether or not the cooperative and competitive versions had any significant differences in results, and the question remains as to whether or not these children were given an unfair advantage in answering the prompts. It is more than possible, that in the stop-and-think task, the participants were more likely to respond with the location that was most recently discussed, which would yield a correct answer. In the disappear task, if there is no where else to look, because the chocolate (or book) is no longer in the story, it is likely that the participants would choose the last known location rather than indicate an alternate location into which the chocolate (or book) never moved. Even the Standard Displacement task in Wimmer and Perner’s second set of tasks was altered to make it easier for the participants. Changing the belief question gave the participants (about 50%) the opportunity to respond non-specifically, like “He will look for the chocolate.” In those cases, the investigators had to reform the prompt question. It is impossible to determine whether this helped or hindered the participant’s conception of the story. However, based on these results, Wimmer and Perner (1983) claim that “correct performance in all these tasks depends on correct representation of two different or even conflicting epistemic states” (126).

In an effort to enlighten the cognitive difficulties of autistic children, Baron-Cohen, Leslie, and Frith (1985) employ Wimmer and Perner’s false belief paradigm because it is a “convincing demonstration that an explicit theory of mind is well within the capacity of the normal four-year-old” (39). In addition to twenty autistic children and fourteen Down’s Syndrome children, they administer their task to twenty-seven clinically normal pre-school children with a mean age of 4;5 (years;months). They alter Wimmer and Perner’s (1983) standard displacement task creating an easier task with the same conceptual complexity that consisted of two dolls, heretofore known as the Sally-Ann task. The first doll, Sally, placed a
marble into a basket and then left the scene. In her absence, the second doll, Ann, removed the marble from the basket and placed it into a box. Then Sally returned. The experimenter asked the participant, “Where will Sally look for her marble?” Baron-Cohen, Leslie, and Frith (1985) also asked two control questions: Where is the marble really? and Where was the marble in the beginning?. Although it is not clearly stated, it is assumed that the control questions were asked immediately after the belief question. The Sally-Anne task has become the ‘standard’ false belief task.

All participants correctly answered both of the control questions. The normally developing children passed the belief question at a rate of 85% (23 out of 27), the Down’s Syndrome children at a rate of 86% (13 out of 15), and the autistic children failed the belief question at a rate of 80% (16 out of 20). This leads Baron-Cohen, Leslie, and Frith (1985) to conclude that autistic children as a group fail to employ theory of mind.

Perner, Frith, Leslie, and Leekam (1989) created the Smarties Box task, or the deceptive-appearance task, which is another of the popular false belief tasks. This task is administered as a final task in a series. There are two experimenters and one indicates that he or she is going to get the next participant, and states the next participant’s name. After that experimenter leaves the room, the remaining experimenter pulls from a bag a Smarties Box, a popular confection in Europe. The participant is asked, “What’s in the box?” to which the reply of all participants was Smarties or sweets. The experimenter then opens the box and reveals that there is actually a pencil inside, then checks to be sure the participant remembers the chain of events by asking two memory questions: What’s in here? and When I first asked you, what did you say? The experimenter continues by stating that the following participant has not seen the box and asks, “When s/he comes in, I’ll show her/him this box just like this and ask: [Name] what’s in here?
What will [Name] say?” (692). Perner, et al. (1989) only tested autistic children, who had a chronological age between 7;5 and 18;10 and a mental age (assessed by the British Picture Vocabulary Test) from 3;1 to 12;8, and children with specific language impairment, who were chronologically 6;11 to 9;11 and had mental ages (assessed by the British Picture Vocabulary Test) of 5;5 to 8;7, there was not a non-clinical group. All participants correctly answered the prompt questions, but only nineteen (out of twenty-three) correctly answered the false belief question. These results closely resemble those obtained by Baron-Cohen, Leslie, and Frith (1985).

With the results from Wimmer and Perner (1983), Baron-Cohen, Leslie, and Frith (1985), and Perner, et al. (1989) in hand, the false belief task is used by scores of researchers to evaluate the ToM of clinical populations including children with autism (Happe, 1995; Tager-Flusberg & Joseph, 2005), children with specific language impairment (Miller, 2001), and deaf children (Peterson & Siegal, 1999; Woolfe, Want, & Siegal, 2002). The results are also reinterpreted and said to give evidence of social cognition (Bjorkland, Cormier, & Rosenberg, 2005; Filippova & Astington, 2008), moral reasoning (Astington, 2004), and metacognition, or knowledge about knowledge (Kuhn, 2000).

2.2.2 Language and ToM

There is an intrinsic relationship between language and false-belief understanding (hence ToM). It may be that this relationship reflects the fact that it is necessary to understand language for the implementation of false belief tasks, but it seems more likely that language plays a causal role in false belief understanding. The importance of language with regard to ToM is the subject of much debate. Assuming that language does play a causal role, as many do, the precise aspect of language which is relevant for its role in ToM then becomes the topic of dispute. The most
common aspects of language that are considered to be influential for ToM, although the direction of the relationship remains to be determined, are syntax and semantics.

### 2.2.3 Syntax

Under the premise that ToM development “depends on language such that linguistic development supports theory-of-mind development,” (1312), Astington and Jenkins (1999) undertake a longitudinal study to discover the relationship between the two. They recognize three possibilities: language depends on ToM, ToM depends on language, and both language and ToM depend on some third factor such as executive function or working memory. Leaning towards the idea that ToM depends on language, especially because mental state reports require complex constructions, Astington and Jenkins (1999) develop a study to prove their hypothesis.

Using assessments of general syntactic and semantic development, as opposed to tasks that investigate understanding of object complements or mental terms, Astington and Jenkins (1999) studied the ToM task performance and level of language development in 3 year olds at three points in time over seven months. They used variants of the unexpected contents task (a different task at each time interval) and the change-in-location false belief task to test for ToM. They used the Test of Early Language Development (Hresko, et al., 1981) to test for language ability because it uses both questions and pictures to assess syntactic and semantic skills in both expressive and receptive forms.

Astington and Jenkins (1999) used the syntax and semantics scores as separate variables, and they determined that semantics made no additional contribution to the prediction of ToM after syntax was entered, but if semantics was entered into the regression first, syntax did make an independent contribution. With this result, Astington and Jenkins (1999) conclude that there
is a directional relation between language and ToM, and specifically, that the development of syntax promotes ToM development.

Of particular interest on the syntax side of the relationship between language and ToM is the de Villiers and Pyers’ (2002) longitudinal study tracing the relationship between various measures of spontaneous language production and comprehension and false-belief understanding. They concentrate on the emergence of sentence forms involving mental state verbs, such as want, need, think, and know, and their complements because this linguistic achievement roughly coincides with children’s successful performance on standard false-belief tasks. The contention is that children who are not able to represent the semantics of a sentence like

(1) Sarah thought the earth was flat.

are not in a position to understand talk about false-beliefs because their grammars do not allow “the appropriate accommodation of the proposition from the possible world under the complement-taking verb” (1039). The children who are unable to understand the complement clause appear to find a reading in which the earth was flat, not one regarding Sarah’s thoughts.

De Villiers and Pyers (2002) use a series of language tasks to elicit different complement structures using both mental state and communication verbs. In their array of tasks, they include the unexpected contents (Perner, Leekam, & Wimmer, 1987) and the unseen displacement (Wimmer & Perner, 1983) as tests for false-belief understanding. They administered these tasks in several rounds, months apart. They found that the participants who passed the complement tasks and failed the false belief tasks were able to pass the false belief tasks in the subsequent round. However, the participants who failed the complement tasks also failed the false belief tasks. Therefore, the score on complement tasks predicts the score on the subsequent round of
false belief tasks and the score on the false-belief tasks does not predict language ability as measured in the next round. This indicates that mastery of complements precedes, if only by a short while, the passing of false-belief tasks. De Villiers and Pyers (2002) contend that “a child who fails to retain the appropriate syntactic representation for a complement construction will not have it available as a form of mediating representation for false-belief-understanding” (1057). This is compatible with the claim that children require full access to many mental verbs plus sentential complements in order to represent the beliefs of other people.

2.2.4 Semantics

Children tend to use mental state verbs, like those described by de Villiers and Pyers (2002), as early as two years old, but the proper use of these verbs does not entail ToM until later. This issue is addressed by Olsen (1988). He argues that intentional states are “the product, first, of representing condition-action relations in the form of propositional representations,” (420) then the children progress to representing those representations with meta-representations. In other words, children begin by acquiring the necessary vocabulary, the appropriate linguistic structure for “stating propositions and for making requests and promises” (421), then proceed to acquire a ToM. Olsen (1988) acknowledges that children’s behavior may be appropriate in ToM terms before the acquisition of the required language. The meta-representational stage, when they acquire the concepts that make up ToM, is that at which ToM is developed, after which, children become subject to awareness of thought. Olsen (1988) believes that the semantic representation is available before the syntactic representation, but without an avenue to use to express ToM, it is difficult to prove. Whether or not it is possible to test the semantics of ToM without confounding a study with syntax remains to be determined.
2.2.5 Language in General

Nelson (2005) believes that the attribution of false belief and the corresponding mental state terms are not ToM itself, but a necessary component of the greater Community of Minds. She believes that language matters for ToM because ToM is not “an individual possession but part of a communally shared belief system about human goals, aspirations, motivations, knowledge systems, and value systems” (45). She justifies the data regarding atypical populations (deaf children, autistic children) as due to the lack of experiences with linguistic communication, regardless of the reason, and a therefore, delayed or nonexistent ToM. Nelson (2005) considers false belief, similar to pretense or deception, to be an important but small accomplishment within the continuum of mature ToM. She argues that it is the acquisition of language that has a maximum impact on all social and cognitive functioning. A child must comprehend the contents of another’s belief, not the concept of belief. In the process of listening to the community’s stories and conversing with its adults, the child gains access to the concerns of the Community of Minds. Nelson (2005) argues that it is precisely around the time that children begin to pass the false belief task that they are beginning to understand the language of the mind. This language includes attributing thoughts to other people (He thinks that…), claiming knowledge (I know that…), stating beliefs (I’m sure that…), and using mental-state language for a variety of other purposes (I guess…; Remember when…; Imagine that…). Children must understand that the verbs think, know, and remember not only refer to mental states, but also that the propositions that follow these verbs represent the mental contents of the person to whom the mental state is ascribed. This requires “abstraction from the real world of experience…where referents are matters of communal agreement on shared concepts, not material parts of the observable world” (35-6). Nelson believes that children acquiring the
terminology to talk about the mental states of others is an indication that they are on the path to a community of minds, not that they are a member. Children as young as two years old are known to use these mental state verbs in conversation, but they still do not know about knowing. They remain ignorant of how shared knowledge comes into being.

Along the same lines as Nelson, Ruffman, et al. (2003) also found that general language ability correlates with ToM ability. Based on their criticism of earlier researchers who determine that ToM is preceded by either syntax or semantics using language tests that confound the two, Nelson, et al. (2003) use what they consider better, but not perfect, tests of syntactic and semantic ability. As syntax and semantics can never be completely separated, they use picture tests to distinguish between the two rather than simply verbal tasks. For example, a child would be asked to choose which picture represented a mouse under a chair when shown a set of pictures including a mouse under a chair, a chair under a mouse, and a mouse on a chair. While this test is intended to test syntactic ability, based on word order, it is necessary for the participant to understand the meaning of the preposition under as opposed to on, thereby adding a semantic component. The semantic versions of the test asked the child to choose which picture represented, for instance, the situation described by ‘He will eat the apple.’ from pictures of a man walking away from an apple, a man holding an apple in front of his face, and a man with an eaten apple on a plate. The argument is that it is “impossible to eliminate all semantic demands from a test of syntax” (142), but the syntax tests placed higher demands on understanding word order in comparison to the semantics tests.

In their longitudinal study, Ruffman, et al. (2003) found that before accounting for the age of the participant, semantics was as good a correlate of belief as syntax. In their two experiments, the first resulted in no unique variance over and above semantics. The second
showed that the combination of syntax and semantics accounted for considerably more variance than syntax alone. For this reason together with the undeniable interdependence of syntax and semantics, Ruffman et al. (2003) conclude that false belief correlates with general language rather than simply syntax or semantics.

2.2.6 Validity of False Belief

Any of the false belief tasks are inherently difficult, primarily because it goes against intuition. Beliefs are supposed to be true. Bloom and German (2000) argue that “even for a child who clearly understands that beliefs can be false, getting the right answer places non-trivial processing demands” (27) on the child participant. Children must set aside a current, salient situation and generate an answer based on a counterfactual state of affairs, or where the object would have been had it not been moved.

Furthermore, Bloom and German (2000) cite a study by O’Neill (1996) in which two-year-olds observed an attractive toy being placed on a high shelf. The child’s parent was either present or absent. When later asking the parent for help in retrieving the toy, the children were more likely to name the toy and gesture to the location when their parent was absent for the placement. If the parent was present, the children were more likely to simply gesture. This suggests that children as young as two are aware of the knowledge states of other people and alter their behavior accordingly. This study also suggests that two year old children possess the ability to discern another’s belief state. Bloom and German (2000) recommend that the false belief task be used, not as a test of ToM, but to explore the difficulty of reasoning about different representations and as a diagnostic test for adults with cognitive and linguistic impairments.

In a study that examines the processing costs for adults when confronted with a false belief, Apperly, et al. (2007) find that a false belief causes more processing delays that an
unrelated belief. The experimenters tested undergraduate students with two sentences together with a picture probe, which depicts a man sitting in a chair next to a table and a chair with a ball on the seat. The sentences were of the type: (a) He thinks the ball on the chair is red and (b) Really the ball on the chair is yellow. The participants were asked to identify whether or not the color picture correctly represented the belief of the man. Apperly, et al. (2007) determine that when the man in the picture had a false belief, the reaction time of the participants was significantly longer than those in which the man in the picture had a completely unrelated belief, for example, the color of the ball was blue. This study begs for a re-evaluation of the traditional false belief tasks used with children. If adults are plagued with processing delays due to a representation of false belief, it is highly likely that young children would experience at least the same, if not a greater, dilemma.

Contrary to the standard false belief view is that of Lalonde and Chandler (2002), who strongly believe that children obtain a “copy theory” of mind, not ToM itself, at around four years, then an “interpretative Theory of Mind” later on. They believe that ToM is not only the ability to represent a false belief, but also to know that two people can witness the same event and come away with different interpretations of that event. Rather than one event that establishes ToM, there are two. The first is the ability to attribute a false belief to themselves or others and the second to achieve an interpretative ToM. Lalonde and Chandler (2002) argue that a participant’s understanding of Maxi’s false belief is an invalid test for establishing the presence or absence of an interpretive ToM. Because Maxi and his mother witness two different events, the false belief task does not “require the child to jointly represent the same state of affairs in contradictory ways” (166). Therefore, it is not actually a false belief at all, but only a causal relationship between what was seen and what was believed.
Using Droodles, popularized by Roger Price (1953), which show only a small nondescript part of a picture, Lalonde and Chandler (2002) tested five-, six-, and seven-year-olds as well as adults for false belief as well as interpretive understanding. The task entailed showing the participant and one of two dolls a picture of, for example, a ship and a witch as two separate figures on the same piece of paper. Then the experimenter covers the majority of the picture so only the bow of the ship and the tip of the witch’s hat remain visible. The participant is then asked what someone else, usually the second doll, will think it is in the picture. The participant is now the holder of “privileged information” (169). If the participant can correctly attribute an ignorance or a false guess to the second doll, then the participant is said to have an interpretive ToM. While extremely similar to previous false belief tasks, the difference lies in the interpretation of the picture and the participant’s ability to attribute an alternate interpretation of the restricted view to another person.

In their study, Lalonde and Chandler (2002) used dolls to represent the character who was “in the know” as well as the ignorant character. They found that the majority of children, regardless of age, were able to pass the traditional false belief tests as described above. However, only 40% of the children were able to attribute different beliefs to the two dolls when they were presented with the same information. Only the seven-year-olds appeared to have mastered both. Lalonde and Chandler (2002) use this information to argue that children do not acquire their last ToM at age four, but it is at least a two level process, and the second level is acquired later. They conclude with “children begin their careers as theorists of the mind by recognizing that others can ‘get things wrong’ (196), as in the false belief task; then “the children progress to the realization that there is more than one way to be wrong (interpretation); then to more sophisticated notions of interpretation that include the possibility that there is
(perhaps) more than one way to be ‘right’; and eventually to the view that any and all claims to knowledge rest upon finding the best available warrant for what must remain fundamentally doubtful knowledge claims” (196). Lalonde and Chandler (2002) offer the most reasonable explanation, so far, for what happens after preschool with regard to ToM. Intuitively, the false-belief task cannot be the be-all and end-all of ToM, judging by the obvious differences between four-year-old children and adults.

2.2.7 ToM Tasks for Older Children

Most researchers agree that the false belief task, although an enormous milestone, is just the beginning of ToM. Therefore, children who successfully pass the traditional false belief tasks are said to have achieved a first order ToM. To more realistically participate in social interaction, it is necessary not only to think about other people’s thoughts, but to think about what people think about other people’s thoughts. This is second order ToM.

The first to create a task to test second order ToM were Perner and Wimmer (1985). They create a story in which two characters, John and Mary, were independently informed of the location of the ice cream man. In reality, they both know where the ice cream man was, but John was underinformed about Mary’s knowledge. John and Mary both saw the ice cream van at the park. After Mary went home to get some money, John spoke to the ice cream man who said he was going to the church. On his way to the church, the ice cream man passed Mary’s house, at which time they had a conversation about his intention. Later, after Mary left home to go to the church for ice cream, John went to her house. Mary’s mother told John that she went out for ice cream. The participant is now reminded that John does not know that Mary talked to the ice cream man. John goes to find Mary. The participant is now asked where John will go to find Mary. A child with second order ToM will successfully respond with to the park, knowing that
John does not know that Mary knows that the ice cream man went to the church. A zero or first order ToM will yield a response of *to the church*, because that is where the ice cream man in (zero order) and that is where John thinks the ice cream man is (first order). Perner and Wimmer (1985) administered this task to children in grades one through four (seven to ten years old). There were twenty-four participants in each grade. The first graders passed the above version of the story at a rate of 25%, 67% of the second graders passed, 58% of the third graders, and 100% of the fourth graders. The experimenters took out the memory aid sentence, *Don’t forget, John does not know that Mary talked to the ice cream man*, which dramatically reduced the pass rate to 17%, 42%, 50%, and 67% (first through fourth grade respectively).

Perner and Wimmer (1985) make several alterations to this task and test more children. They are impressed with the number of first and second graders that do well on the second order tasks, under what they consider optimal conditions. This task sheds some light on the fourth graders, though, who do quite well, especially with the memory aid. The results of this study indicate that by his or her tenth birthday, a child should be able to achieve at least a second order ToM.

Happe (1994) creates a series of more naturalistic and complex stories for older children to test the comprehension of non-literal utterances. She used these tests primarily to test ToM development in autistic children. Happe tested autistic children who failed to pass the first-order false belief tasks, autistic children who passed the first-order but failed the second-order false belief tasks, mentally handicapped children who passed both false belief tasks, mentally handicapped adults who did not score perfectly on the first order false belief but performed well on everything else, typically developing children, and typical adults. Each group was given a series of first-order and second order false belief tasks together with a set of “strange stories”
created by Happe. The strange stories consisted of twelve types: lie, white lie, joke, pretend, misunderstanding, persuade, appearance/reality, figure of speech, sarcasm, forget, double bluff, and contrary emotions. These stories did not involve mental states. For example, the lie story is as follows:

One day, while she was playing in the house, Anna accidentally knocks over and breaks her mother’s favorite vase. Oh dear, when mother finds out she will be very cross! So when Anna’s mother comes home and sees the broken vase and asks Anna what happened, Anna says, “The dog knocked it over, it wasn’t my fault!” (148)

This story was followed by two questions: Was it true, what Anna told her mother? and Why did she say this? Each of the strange stories tasks was accompanied by a picture.

As expected, performance on the false belief and deception tasks by the autistic children accurately predicted the performance on the strange stories tasks. The autistic children did not use fewer mental state justifications, including cognitive terms like think, than the control groups, but used them inappropriately given the context. For example, “he thinks a lawnmower cut her hair” was a response for one of the stories which involved neither a lawnmower nor hair.

Happe’s (1994) study accomplishes two goals. First, the more naturalistic “strange stories” validate the traditional false belief tasks eliminating doubt regarding the complexity and realism by creating real-life situations that are far more difficult to interpret. Second, Happe’s study indicates that there may be a connection between the understanding and appropriate usage of mental state vocabulary and ToM. This will become important in further research evaluating the relationship between propositional attitude verbs and ToM.

Flavell, Green, and Flavell (2000) extend the findings of traditional ToM tasks by examining the introspection abilities of 5-year-olds, 8-year-olds, and adults. In the first
experiment, the Think Task, participants were asked to think of something they liked to do and
something they did not like to do. They were then asked to report their thoughts. All three
groups reported thought content. The adults gave longer reports then the children, were more
accurate in recalling the order and content of their thoughts, and seemed to actually introspect
rather than just list the things they did and did not like to do.

In the second experiment, the Not-think Task, participants were asked not to think for a
short period of time. The adults and the majority of 8-year-olds, but only a few of the 5-year-
olds reported having some thoughts anyway. Older participants also reported mental strategies
used to prevent thoughts from occurring and expressed difficulty in not thinking. Flavell, Green,
and Flavell (2000) offer possible reasons to the lack of introspective abilities in the younger
children, some of which seem more plausible than others. These include such possibilities as the
five-year-olds had no thoughts while participating in the not-think task, the five-year-olds did
have potentially noticeable, conscious thoughts but they were less able to notice them, the five-
year-olds did have conscious ideation and did notice it, but did not construe it as thoughts and
did not report it, the five-year-olds lacked the verbal ability to make a full report of their
thoughts, or they may have thought that they would be reprimanded for having thoughts when
they were told not to and therefore did not report any although they not only had thoughts, but
were fully aware of them. It seems likely that the five-year-olds in this study did have thoughts
but were unaware of the thoughts as thoughts or could not express the thoughts due to a lack of
expressive power or vocabulary.

A group of five year olds that lacks introspection capabilities gives evidence to the idea
that ToM is a multi-stage phenomenon. Assuming, based on the false belief tasks described
above, that many of the children involved in Flavell, Green, and Flavell’s (2000) study could
have passed the first order ToM, but remain unable or unwilling to describe their thoughts, there must be another stage at which ToM becomes more developed. While eight year olds were better, but still not as proficient as adults, these results together with those of Perner and Wimmer (1985) and Lalonde and Chandler (2002) indicate that a full ToM is not acquired until, at a minimum, pre-adolescence.

The previous literature on ToM indicates that children around four or five years old should be able to pass the false belief test, and therefore are considered to have ToM. However, it also indicates that ToM is more involved than simply the false belief task. Children progress in their ability to attribute thoughts and beliefs to other people until they reach pre-adolescence, when they become more adult-like.
3 Research Niche

As is clearly demonstrated in the above literature, specifics regarding the acquisition of modality as well as the specifics regarding the language of ToM remain to be determined. This study proposes an interdependence between the language of ToM and the corresponding level of ToM and modality. The concept of interdependence between modality and ToM comes from the idea that the language traditionally used in expressions commenting on the thoughts and beliefs of other people uses mental state verbs, also referred to as propositional attitude verbs, together with the corresponding complements. The interpretation of attitude ascriptions receives full attention in the literature in semantics, as part of a systematic project of accounting for natural language meaning. One theory that addresses attitude ascriptions is that of Hegarty (2006, 2010).

Hegarty (2006) proposes a covert modality in the semantics of propositional attitude verbs such as claims, insists, thinks, believes, and imagines, among others. Using a dynamic semantics approach in which “each stage of a discourse is characterized by an information state reflecting the possibilities which are compatible with the discourse to that point” (2), Hegarty (2006) shows that each propositional attitude verb involves a relation to a modalized information update condition. For example, the sentence

Alex claims that Sandy won the Nobel Prize.

attributes to Alex the belief that Sandy must have won the Nobel prize. In other words, in Alex’s view, it is not a possibility that Sandy did not win the Nobel Prize. This is compared with

Alex thinks that Sandy won the Nobel Prize.

in which the belief that Sandy should have won the Nobel Prize is attributed to Alex. The ascription to Sandy using think asserts an information update condition on the information state
(or context) which speaker and addressee attribute to Alex in some, not necessarily all, accessible worlds. Hegarty (2006) concludes from instances such as these that there is a covert modal operator in sentences with propositional attitude verbs.

If Hegarty (2006) is correct, then there should be a direct correlation between the acquisition of modality and the acquisition of Theory of Mind. This correlation has been mentioned by those investigating issues in modality as well as those investigating issues of Theory of Mind, but never tested. Children should acquire the different types of modality (epistemic, deontic, alethic, etc.) shortly before they acquire the ability to attribute thoughts and beliefs to other people with the use of the propositional attitude verbs that covertly carry such modal notions.
4 The Study

4.1 Participants

The participants were 49 children (26 female, 23 male) in first grade (6-7 years old), 22 children (12 female, 10 male) in third grade (8-9 years old), and 15 children (13 female, 2 male) in fifth grade (10-11 years old) at a university laboratory school. The parents of all students in first, third, and fifth grade were asked to volunteer their children for an interview. All of the children whose parents consented were included in the study. All participants were native speakers of American English.

4.2 Method

Each child was removed from his or her regular classroom and taken to a room with only the interviewer. The children were told that they would be told several stories and asked questions about each story. Then they would be shown some pictures and asked questions about the pictures. They were also told that all answers were correct to eliminate concern about evaluation. Each interview was videotaped. All tasks were delivered in the same order to each participant, beginning with the Theory of Mind tasks, in order from first to fourth order ToM, then proceeding to the modality tasks. Each interview lasted approximately ten minutes.

4.3 Tasks

4.3.1 ToM tasks

A total of four Theory of Mind tasks were administered. The first order ToM task was the Sally-Anne task (Baron-Cohen, et al., 1985). During the Sally-Anne task, the children were read the story while they looked at a picture of the progression of the story (see Appendix 1). After the story, each child was asked, “Where will Sally look for the ball?” Regardless of the answer, each child was told they were correct upon answering the question.
The second order, third order, and fourth order ToM tasks (see Appendix 1) were created by Liddle and Nettle (2005). Each story was told to the participants without a visual aid. Because Liddle and Nettle (2005) use British English, some vocabulary items were altered (football manager was changed to football coach) to limit confusion. None of the changes affected the meaning of the stories. After each story was told, the participants were asked a memory question and either one or two ToM questions. The prompts were also changed from those used by Liddle and Nettle (2005) to create questions for the participants to answer rather than statements for the participants to judge as true or false. Again, regardless of the answers, each child was told they were correct upon answering the questions.

The second ToM task was a story about Johnny and Bob. They are friends and both tried out for the football team at school. Johnny was under the impression that the coach was more interested in Bob, although the coach was equally interested in both. The prompt question was *Who does Johnny think the coach wants to play on the team?* The only passing answer was *Bob*.

The third ToM task was a story about James, who unbeknownst to his teacher, cheated on an oral spelling test by reading the letters off of a poster in the classroom. The teacher in the story asked James to spell the word ‘balloon’. James saw the word ‘balloon’ on a poster in the classroom and therefore, correctly spelled the word although he did not know, without the poster, how to spell the word. An affirmative answer to the question *Does James think that Mrs. Smith believes that he knows how to spell balloon?*, was rated as a pass.

The fourth ToM task was a story about two children, Sarah and Joe, who were given an opportunity to bring a video into school as a reward for good behavior. The teacher recommended that they bring in one that she would also like. The two students had trouble deciding what kind of video to bring as they had different favorites. Sarah deceives Joe by
telling him that she knows what the teacher would like. This task had two questions. The first question, *Does Sarah hope that Joe would know that she didn’t know what Mrs. Brown wanted?*, required a negative response, and the second question, *Does Sarah hope that Joe would believe that she knew what Mrs. Brown wanted?*, required an affirmative response.

### 4.3.2 Modality tasks

The modality tasks consisted of pictures (see Appendix 2). The first modality task was a two-part task. The first part was a picture of a tree with a cat in it, a short ladder leaning up against the tree, and a sad blue character underneath the tree. Each participant was told, “This is Tommy” while the interviewer pointed to the blue character; “and this is Tommy’s cat” pointing to the cat in the tree; “See the ladder, how short it is? Why is Tommy sad?” The second part of the first modality task was a picture that included the same cat and tree as the first part, but a longer ladder and a happy blue character. The interviewer said, “In this one, the ladder is much longer. Why is Tommy happy?” The first part of task one, Sad Tommy, was intended to have the participants prime themselves for a modal response in the second part, Happy Tommy. Therefore, a modal response was not expected in the first part.

The second modality task was a cartoon picture of a tree with a dark cloud over it (see Appendix 2). The participants were asked, “What does it mean when there are dark clouds in the sky?”

The third modality task was a cartoon picture of a jacket. The participants were asked, “How come sometimes you bring a jacket to school even though it’s warm outside?”

The fourth modality task was a picture of a tube of toothpaste and a toothbrush. The participants were shown the picture and asked to pretend that they were a dentist. “What do you say to someone who has dirty teeth?”
The final modality task was again a two-part task. The participants were shown a picture of a tree with an umbrella caught in the branches. The interviewer said, “See the umbrella in the tree? How did it get there?” After an affirmative response, the interviewer asked if that was the only way for it to get there. Upon a negative response to the first part, the interviewer prompted the participants for an alternate response.

4.4 Data

4.4.1 Theory of Mind Tasks

The following chart gives the number of participants that passed each Theory of Mind task as well as the corresponding percentages. To see the results for each child, please see Appendix 3.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>ToM Task 1</th>
<th>ToM Task 2</th>
<th>ToM Task 3</th>
<th>ToM Task 4a</th>
<th>ToM Task 4b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
</tr>
<tr>
<td>First Grade</td>
<td>13</td>
<td>26</td>
<td>40</td>
<td>80</td>
<td>34</td>
</tr>
<tr>
<td>Third Grade</td>
<td>13</td>
<td>59</td>
<td>19</td>
<td>86</td>
<td>21</td>
</tr>
<tr>
<td>Fifth Grade</td>
<td>9</td>
<td>60</td>
<td>15</td>
<td>100</td>
<td>14</td>
</tr>
</tbody>
</table>

4.4.2 Modality Tasks

Figure 2 gives the number and percentages of participants who answered the modality tasks with a modal. Responses were considered modal if they included a modal auxiliary or any other expression of possibility or necessity (for actual responses see Appendix 4).
Table 2

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Task 1 (a or b)</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5 (a or b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number</td>
<td>percent</td>
<td>number</td>
<td>percent</td>
<td>number</td>
</tr>
<tr>
<td>First grade (n=49)</td>
<td>43</td>
<td>84</td>
<td>46</td>
<td>94</td>
<td>40</td>
</tr>
<tr>
<td>Third grade (n=22)</td>
<td>22</td>
<td>100</td>
<td>18</td>
<td>82</td>
<td>15</td>
</tr>
<tr>
<td>Fifth grade (n=15)</td>
<td>13</td>
<td>87</td>
<td>15</td>
<td>100</td>
<td>13</td>
</tr>
</tbody>
</table>

Combining all age levels, the average percentage of participants who uttered a modal during each task is represented in the following chart.

Table 3

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Task 1 (a or b)</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5 (a or b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td>92</td>
<td>81</td>
<td>44</td>
<td>80</td>
</tr>
<tr>
<td>All participants (n=86)</td>
<td>90</td>
<td>92</td>
<td>81</td>
<td>44</td>
<td>80</td>
</tr>
</tbody>
</table>
5 Analyses

5.1 Analysis of ToM tasks

Because of the ToM studies previously described, it was assumed before this study began, that very few of children above age five or six would fail the standard displacement task. Therefore, it was assumed that first graders, who are six or seven years old, would generally pass thereby offering a baseline for the subsequent levels of ToM. As shown by the results of the first ToM task, this was not the case.

The first ToM task used in this study was the standard displacement, essentially the Sally-Ann task as described by Baron-Cohen, Leslie, and Frith (1985). Out of twenty-seven of Baron-Cohen, Leslie and Frith’s participants with a mean age of 4;5, twenty-three passed this task yielding a pass rate of 85%. Out of forty-nine 6 and 7 year old first graders in the current study, thirteen passed, yielding a pass rate of 27%.

It is not surmised that the failure of the Sally-Ann task by such a large number of participants is a deficit in cognitive ability, only that there is a difference between the current study and the one administered by Baron-Cohen, Leslie, and Frith (1985). The major difference between the two studies was the method of delivery of the false belief task. Baron-Cohen, Leslie and Frith (1985) acted out the Sally-Ann task with puppets. In the current study, the story was read to the participants while they looked at the pictures (see appendix A). In order for this variation to lead to such a significant difference in pass rate, the method of delivery must be critical. Astington & Baird (2005) also expected that the method of delivery would have an impact on the results of the false belief task. They created a study using the three versions of the standard displacement task: one in which the story was acted out while being told and the participants saw the transfer of the object (the chocolate being moved from the drawer to the
cabinet), another in which the participants watched the story but the movement of the object was not visible, and finally a version in which the whole story was only seen without verbal commentary. Astington and Baird (2005) saw no difference in the three delivery methods. Children who passed the false belief tasks, passed all three versions, and children who failed the false belief tasks, failed all three. Only seven out of forty-four participants showed any differential response and “there was no hint of condition or order effects in these seven” (169).

Astington & Baird began this study hypothesizing that the false belief task would be easier and therefore attainable by younger children if the children did not see the object in the new location. However, there is still a significant difference between the current study and that of both Baron-Cohen, Frith, & Leslie (1985) and Astington & Baird (2005). Intuitively, it is logical that a verbal representation of a story such as in the current study requires more cognitive processing than one in which the story is acted out as well as narrated. The results of the first ToM task together with the results from previous false belief tasks shows that a picture is far less salient for children than an acted out version of a story. Although, together with the following three tasks (discussed below), all of which are only given orally, the results from Task 1 indicate that it may not be the lack of actors that cause the difficulty, but the lack of the Stop and Think condition added by Wimmer and Perner (1983) and purportedly used by Baron-Cohen, Leslie, and Frith (1985) that caused the difference. It should be noted that Baron-Cohen, Leslie, and Frith (1985) do not explicitly state whether or not this condition was used; it is only the large difference in results that leads to this conclusion.

ToM tasks 2, 3, and 4 are far more language based than the Sally-Ann task. All three stories were only verbalized to the participants. The levels of ToM correspond to the levels of recursion in the story and prompt question. Therefore, a second order task would include a belief
about a belief, and a third order task includes a prompt regarding a belief about a belief about a belief, and so on. If the variables $x$, $y$, and $z$ represented characters in a story, a third order question would ask *What does $x$ believe that $y$ believes that $z$ believes?* Most adults perform better than chance up to the fourth level (Kinderman et al., 1998) when the number of embedded structures becomes difficult to conceptualize. This study is no exception. As shown by the results, the percentage of participants who pass the second, third, and fourth ToM tasks goes up as the age of the participants increases, except for Task 4a in which all age groups performed very close to chance.

![Figure 1 ToM Tasks 2-4](image)

The first graders show a steady decline in pass rates as the tasks become more difficult, beginning with an 80% in the second order, Task 2. The results for tasks 3 and 4b for the first graders are only slightly above chance, which allows the possibility that the participants guessed the correct (or incorrect) answer.

The third graders clearly separate themselves from the first graders in Task 3. This shows that third-order ToM tasks are attainable by 8-9 year olds, but not 6-7 year olds. The third graders perform on par with the fifth graders for Task 3 and Task 4b.
Temporarily disregarding Task 4a, the fifth graders show only a slight decline as the tasks become more difficult, achieving an 87% pass rate on the most difficult.

Task 4a, however, is undoubtedly the most difficult task of the battery, with participants of all age levels performing at chance. This is attributed to not only the complex syntactic structure, but also the addition of a negative in the prompt. Recall, the prompt for Task 4a was *Does Sarah hope that Joe would know that she didn’t know what Mrs. Brown wanted?* It is, therefore, assumed that a negative compounds the difficulty, making it almost incomprehensible, even for those who can appropriately answer a quadruple embedded question.

Using the pass rate as a measure for the tasks, the order of difficulty of the ToM tasks as they stand for all grade levels combined from most difficult to least is the following: 4a (negative), Task 1 (Sally-Ann), 4b, 3, then 2. However, given that both the third graders and the fifth graders passed both Task 1 and Task 4a at approximately the same rate, the difficulty was determined by the number of third and fifth graders who passed one but not another. If a participant can pass a difficult task, it is assumed that he or she can also pass an easier task. Out of those who passed Task 1, those who passed Task 4a were 62%, 32%, and 47% (first, third, and fifth grade respectively). Conversely, Out of the participants in first, third, and fifth grade respectively, out of those who passed Task 4a, those who also passed Task 1 were 62%, 79%, and 100%. For this reason, concentrating especially on the fifth grade participants Task 4a is considered more difficult than Task 1. The order of the remaining tasks also comes from the number of participants who passed the task itself as well as the next easier tasks as shown in the following chart. For example, 85%, 90%, and 100% (first, third, and fifth grade) of participants who passed ToM Task 3 also passed Task 2. The following table represents the percentage of participants from each grade who passed each task as well as the next easier task.
Table 4 Percentage of Participants Who Passed Next Easier Task

<table>
<thead>
<tr>
<th>Grade</th>
<th>if 3 then 2</th>
<th>if 4b then 3</th>
<th>if 1 then 4b</th>
<th>if 4a then 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>first grade</td>
<td>85</td>
<td>75</td>
<td>77</td>
<td>62</td>
</tr>
<tr>
<td>third grade</td>
<td>90</td>
<td>95</td>
<td>71</td>
<td>79</td>
</tr>
<tr>
<td>fifth grade</td>
<td>100</td>
<td>92</td>
<td>89</td>
<td>100</td>
</tr>
</tbody>
</table>

The above table indicates that Task 2 is easier than Task 3, Task 3 is easier than Task 4b, Task 4b is easier than Task 1, and Task 1 is easier than Task 4a.

Considering especially the fifth graders, the high percentages in Table 4 indicate that the appropriate order of difficulty is, as listed above, as follows from hardest to easiest: 4a (negative), Task 1 (Sally-Ann), 4b, 3, then 2. With this result, a graph of the percentage of those who passed each task in that order shows more clearly that the fifth and third grade participants are well above the first grade. It also shows that third and fifth graders are very close. Only in the easiest task are fifth graders well above the third graders.

Figure 2 Percent of All Participants Who Passed ToM Tasks
Barring Tasks 1 and 4a for confounding factors, the above graph together with the percent of those who passed Task 2, indicates that the majority of first, third, and fifth graders have a second order ToM. Also, the data indicates that a majority of third and fifth graders, eight to ten year olds, also have third and fourth order ToM. From this it can be concluded that a full range of ToM is acquired in the majority of children by the time they are in third grade.

5.2 Analysis of Modality Tasks

As previously described, the first modality task has two parts, (a) and (b). The first part (a) was intended to have the participants prime themselves for a modal utterance in the second part. The task concentrated on Tommy’s ability, or lack of ability, to reach his cat. Of the 49 first graders, 29, or 59%, of the participants uttered an ability modal consisting of the phrase “is not able to” or “can’t”. Similar responses were uttered by 20, or 91%, of the third graders, and 11, or 73% of the fifth graders. All of the participants, regardless of age, seemed to understand the task and give an appropriate response. Because of the high rate of modal utterance in part (a) together with the correct use of modality without priming, the results from this task were grouped together with the results of part (b) of the first modality task.

Part (a) of the first modality task was successful in having the participants prime themselves as 34 of the first grade participants, 69%, responded with a modal utterance to the part (b). Of the third grade participants, 19, or 86% responded with a modal utterance, and 13, or 87%, or the fifth graders followed suit.

Each of the modals was individually analyzed and 100% of the modal utterances were classified as having a dynamic modal base with a volitional ordering source and a force equivalent to some. All of the participants who responded with a modal utterance conveyed the meaning that Tommy was happy because he can now reach his cat, or in view of the possible
worlds in which Tommy has the ability or the opportunity to reach his cat, the actualization of Tommy doing so occurs in some of those worlds.

The two tasks (part (a) and (b)) together yield a result of 84%, 100%, and 90% (first, third, and fifth grades respectively) of participants responding with a dynamic, volitional utterance. These numbers are in par with other researchers (Coates, 1987) who list ability modals as one of the first types of modality acquired. When all participants are combined, 90% gave a modal response to task 1.

The second modality task was a picture of a dark cloud over a tree. The interviewer asked each participant what happens when there are dark clouds in the sky. In this case, participants primarily answered in one of two ways. They either said that it was raining or that it was going to rain. Going to was considered a modal with an epistemic modal base, a stereotypical ordering source, and a strong modal force. That is, in all worlds compatible with stereotypical occurrences, it will rain. This was uttered by 46 (94%) of first graders, 18 (82%) of third graders, and 15 (100%) of fifth graders. A total of 92% of the participants uttered a modal in task 2.

The third modality task consisted of a picture of a jacket and the question How come sometimes you bring a jacket to school even though it’s warm outside? The predicted response included expressions like It might get cold later. or Maybe it’ll be cold later. The participants seem to have been primed by task 2 because more often than anticipated the response included a comment on the possibility of rain. However, an equally common response included the possibility of cold in the classroom. As both responses are modal and the evaluation of both modals is equivalent, the suspected priming did not have a negative effect on the study. It should, however, be noted for future uses of these tasks.
*It might be cold in the classroom.* yields an epistemic modal base with a stereotypical ordering source and a weak modal force. In other words, based on what is known from possible worlds compatible with stereotypical occurrences, the classroom is sometimes cold. This, or an equivalent response, was given by 82% of first graders, 68% of third graders, and 93% of fifth graders. Overall, 81% of the participants uttered a modal response to task 3.

Anticipating a response including the word *should* or an equivalent expression of modality, task 4 presented the participants with a picture of a tube of toothpaste together with a toothbrush. The participants were asked to pretend they were a dentist, then tell the experimenter what they tell someone with dirty teeth. The participants responded with an expression akin to *You should brush your teeth.* or *You need to brush more.* In other words, in order to obtain the goal of not dirty teeth, brushing your teeth is a priority. Therefore, these modal expressions represent a priority modal base and a teleological ordering source. These responses can also be evaluated as bouletic instead of teleological, if it is the desire or wish for clean teeth that commands the modal.

Because both responses have the same form, for the purposes of this study, neither is preferred over the other.

It has recently been theorized that imperatives are covertly modal (Portner, 2007). If this is so, then imperative responses would have to be counted as modal responses, and the data reported here would change significantly. Because imperatives are such a large part of the linguistic input that is received by children, this claim must be further analyzed in order to be included in this study. However, the expressions of modality in the priority-teleological task would be 86%, 91%, and 100% (first, third, and fifth grades respectively), or a combined 90% if imperatives were included as modal. This would move the priority-teleological modality to an
equivalent place as epistemic-stereotypical (strong). This claim was not closely evaluated during this study, and therefore will not be included in the results, but should be considered in future studies.

The results from this task, in particular, identify the approximate age of acquisition of priority-teleological (or bouletic) modality because of the significant increase in the use of fifth graders (60%) as opposed to first (37%) and third (36%) graders. Task 4 allows for the conclusion that priority; teleological modality is acquired sometime between third and fifth grade, or between eight and ten years of age. A combined total of 44% of the participants uttered a modal during this task.

The fifth and final modality task was another two-part task. This time the first part was a set-up for the second part, rather than a priming. There was no expectation for modality in the first part. The participant was shown a picture of a tree with an umbrella stuck in the upper branches and asked how the umbrella got into the tree. A common response indicated that the wind blew it up there. After the response, the interviewer asked the participant if that was the only way for it to get there. Just one participant said yes. Of those who responded that there was another way for it to get there, 71%, 82%, and 87% (first, third, and fifth grade respectively) responded with a modal that had an alethic modal base and a realistic ordering source such as Somebody could have put it up there. A combined total of 80% of participants responded in this manner.

When all grade levels are combined, 44% of the participants produced a priority, teleological (or bouletic) modal, 80% produced epistemic, alethic, 81% produced epistemic, stereotypical (weak), 90% produced dynamic, volitional, and 92% produced epistemic, stereotypical (strong). The results were reverse analyzed to verify the order of acquisition of
modals. Of the 44% of participants who produced a priority-teleological modal, 92% also produced an alethic-realistic modal. Of the 80% who produced an alethic-realistic modal, 82% also produced an epistemic-stereotypical (weak) modal. Similarly, of the 81% who produced an epistemic-stereotypical (weak) modal, 88% also produced a dynamic-volitional modal. Finally, of the 90% of participants who produced a dynamic, volitional modal, 92% also produced a strong epistemic, stereotypical modal.

The following graph gives a visual representation of the expressions of modality produced by the participants and shows the steady increase in production from first acquired to last acquired.

![Figure 3 Percent of All Participants Who Passed Modality Tasks](image)

The tasks are ordered hardest to easiest, from left to right, in Figure 3. There is a steady incline of the production of modal expressions with respect to difficulty in both first and fifth grades, and fifth graders consistently produce more modality than first graders. The first graders reach approximately the same level of production as the fifth graders at epistemic-stereotypical (weak) which indicates that each of the preceding types of modal expressions (epistemic-stereotypical (strong) and dynamic-volitional) are acquired by the first grade, or around age 6.
The third and fifth graders produce nearly the same percent of modal expressions in response to the alethic-realistic task, while the first graders lag behind, which indicates that alethic-realistic modality is acquired in approximately third grade or around 8 years old. While all groups respond around chance at the priority-teleological task (not including imperatives), the fifth graders are superior to both the first and third graders which indicates the acquisition of priority-teleological modality around or shortly after fifth grade.

The following chart shows the percent of students in each grade who followed the trend of successfully uttering an earlier acquired modal if they did in a task with a modal judged to be acquired later.

<table>
<thead>
<tr>
<th>Table 5 Percent of Participants Who Passed the Next Easier Task</th>
<th>if priority then alethic</th>
<th>if alethic then weak epistemic</th>
<th>if weak epistemic then dynamic</th>
<th>if dynamic then strong epistemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Grade</td>
<td>89</td>
<td>86</td>
<td>83</td>
<td>95</td>
</tr>
<tr>
<td>Third Grade</td>
<td>88</td>
<td>67</td>
<td>100</td>
<td>82</td>
</tr>
<tr>
<td>Fifth Grade</td>
<td>89</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>All participants</td>
<td>92</td>
<td>82</td>
<td>88</td>
<td>92</td>
</tr>
</tbody>
</table>

From this, it is evident that the order of acquisition of modality in children is epistemic-stereotypical (strong), dynamic-volitional, epistemic-stereotypical (weak), alethic-realistic, then priority-teleological (or bouletic).

5.3 The Interdependence

A comparison of the results from the modality portion of the study and the ToM portion of the study gives evidence of the interdependence of the expressions of modality and the expression of ToM. First, it should be noted that there were four participants, two third graders
and two fifth graders, who gave modal responses to all of the modality tasks and passed all of the ToM tasks. These participants have mastered both modality and ToM as well as validated the tasks used in this study. There were not any participants who did not give at least one modal response or pass one ToM task.

The specifics of the interdependence of modality and expressions of ToM were determined based on the number of participants in each grade who passed each task. The corresponding percentages were then listed in descending order for each grade level (see Table 6 below). Each list was evaluated in comparison to the others. An order of acquisition of all of the tasks in the study was determined. The order was then checked against each participant, similar to the method above, to verify that if one task is determined to be more difficult than another, or acquired later than the other, then the participant was successful in the prior task as well.

All grades had the highest percent in all tasks of either epistemic (strong)-stereotypical modality or dynamic-volitional modality. These two types of modality are rated as equal for the current purposes. Children much younger than those interviewed use both of these types of modality regularly (Coates, 1987), when asking parents for permission (dynamic) or talking about events in the near future (epistemic).

After these basic types of modality, all three groups then successfully pass ToM tasks 2, 3, and 4b. There was only one third grade participant who passed ToM 4b, rated as the most difficult of the three, and did not pass the epistemic (strong) modality task. That participant did, however, pass the dynamic modality task. All other participants who passed ToM 4b also passed the epistemic (strong) and the dynamic modality tasks. Because the first graders are close to chance on anything more difficult than ToM 4b, any subsequent evaluation depends primarily on the third and fifth grades. After ToM 4b, the participants express epistemic (weak)-stereotypical
Table 6 Orders of Acquisition

<table>
<thead>
<tr>
<th>Order of Acquisition for First Grade</th>
<th>First Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemic (strong) – stereotypical modality</td>
<td>94%</td>
</tr>
<tr>
<td>Dynamic – volitional modality</td>
<td>84%</td>
</tr>
<tr>
<td>Epistemic (weak) – stereotypical modality</td>
<td>82%</td>
</tr>
<tr>
<td>ToM Task 2</td>
<td>80%</td>
</tr>
<tr>
<td>ToM Task 4b</td>
<td>72%</td>
</tr>
<tr>
<td>Alethic – realistic modality</td>
<td>71%</td>
</tr>
<tr>
<td>ToM Task 3</td>
<td>68%</td>
</tr>
<tr>
<td>ToM Task 4a</td>
<td>48%</td>
</tr>
<tr>
<td>Priority – teleological modality</td>
<td>37%</td>
</tr>
<tr>
<td>ToM Task 1 (Sally-Ann)</td>
<td>26%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Order of Acquisition for Third Grade</th>
<th>Third Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic – volitional modality</td>
<td>100%</td>
</tr>
<tr>
<td>ToM Task 3</td>
<td>95%</td>
</tr>
<tr>
<td>ToM Task 2</td>
<td>86%</td>
</tr>
<tr>
<td>ToM Task 4b</td>
<td>86%</td>
</tr>
<tr>
<td>Epistemic (strong) – stereotypical modality</td>
<td>82%</td>
</tr>
<tr>
<td>Alethic – realistic modality</td>
<td>82%</td>
</tr>
<tr>
<td>Epistemic (weak) – stereotypical modality</td>
<td>68%</td>
</tr>
<tr>
<td>ToM Task 4a</td>
<td>64%</td>
</tr>
<tr>
<td>ToM Task 1 (Sally-Ann)</td>
<td>59%</td>
</tr>
<tr>
<td>Priority – teleological modality</td>
<td>36%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Order of Acquisition for Fifth Grade</th>
<th>Fifth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemic (strong) – stereotypical modality</td>
<td>100%</td>
</tr>
<tr>
<td>ToM Task 2</td>
<td>100%</td>
</tr>
<tr>
<td>ToM Task 3</td>
<td>93%</td>
</tr>
<tr>
<td>ToM Task 4b</td>
<td>87%</td>
</tr>
<tr>
<td>Dynamic – volitional modality</td>
<td>87%</td>
</tr>
<tr>
<td>Epistemic (weak) – stereotypical modality</td>
<td>87%</td>
</tr>
<tr>
<td>Alethic – realistic modality</td>
<td>87%</td>
</tr>
<tr>
<td>ToM Task 1 (Sally-Ann)</td>
<td>60%</td>
</tr>
<tr>
<td>Priority – teleological modality</td>
<td>60%</td>
</tr>
<tr>
<td>ToM Task 4a</td>
<td>43%</td>
</tr>
</tbody>
</table>
and alethic-realistic modality. These two types of modality were expressed at exactly the same rate in each group, 82% for third graders and 87% for fifth graders. Additionally, all participants who gave either epistemic (weak)-stereotypical and alethic-realistic responses also passed ToM 4b, but not the other way around.

Finally, participants in the first grade scored so poorly on the Sally-Ann ToM task and the priority-teleological modality task (26% and 37%) that they cannot be considered to be included in the first grade repertoire in their current form. The third graders were slightly better on these two tasks with a 59% success rate on the Sally-Ann task and a 36% success rate on the priority-teleological modality task. These are still very low scores, and any evidence from them would be considered non-conclusive. The fifth graders, scored equally on these two tasks (60%), but still not well enough to draw any conclusions from their performance other than the fact that the concepts represented in these two tasks is acquired after fifth grade.

The first graders scored consistently higher on the modality tasks than the ToM tasks, as shown in the graph below. In Figure 4, each set of tasks, modality and ToM, are listed according to the respective scale. So, based on the results from the modality tasks, epistemic (strong)-stereotypical is the lowest on a scale of difficulty, and priority-teleological is the highest. ToM Task 2, also the lowest on the scale of difficulty is then correlated with epistemic(strong)-stereotypical modality because both are the lowest in the respective sets of tasks. This continues for all tasks yielding epistemic(strong)-stereotypical modality with ToM 2, dynamic-volitional modality paired with ToM 3, epistemic(weak)-stereotypical with ToM 4b, alethic-realistic with ToM 4a, and priority-teleological modality with ToM 1. The modality and ToM tasks are grouped together based primarily on the achievement of the older participants. For example, the fifth grade participants all successfully passed both the epistemic (strong) and ToM 2, so they are
grouped together. The third grade participants achieved a pass rate of 100% and 95% on the dynamic-volitional and ToM 3 tasks respectively indicating that they, too, should be grouped.

Similar comparisons of the results on the remaining tasks lead to the grouping of the modality and ToM tasks in the graphs that follow. The following graph (Figure 4) represents only the first grade participants and their scores on each task in order of performance rates. Their consistently better performance on the modality tasks contributes to the conclusion that modality is acquired slightly before ToM.

![Figure 4 First Grade Interdependence](image)

However, by third grade, ToM becomes more prominent than modality.

Recall that in third grade a large majority of participants had passed ToM 2, 3, and 4b. Then in fifth grade modality and ToM begin to even out. Notice, however, that the concepts, both modality and ToM, that are acquired in fifth grade leave modality above ToM, similar to the trend noticed in the first graders.

The give and take of expression of ToM and expressions of modality together with the participants also passing all the tasks that come before gives support to the conclusion that the
two are interdependent. Some modality is required prior to the expressions of ToM, but then after an appreciation of ToM, the remaining concepts of modality emerge.

Figure 5 Third Grade Interdependence

Figure 6 Fifth Grade Interdependence
Figure 7 Comparison of Tasks for All Grades
6 Conclusion

Several conclusions can be drawn from this study. With regard to the false belief task (Wimmer & Perner, 1983), this study shows the significance of the “Stop and Think” portion of the task. The omission of the “Stop and Think” clause together with the very poor results for all participants indicates that the “Stop and Think” aid greatly increases the pass rate of the standard false belief task. This has a profound impact on the subsequent research that uses this task as evidence for ToM in young children as well as evidence for delays in atypical populations. This study gives evidence that the Stop and Think aid does nothing more than prime the participants for the correct answer to the task. With so few of the participants in the current study passing the false belief task, one of two conclusions can be drawn. Either four and five year old children do not have ToM or the false belief task is an insufficient measure of ToM. This result has the potential to void much of the research regarding the ToM of young children. Of course, a comparison of false belief tasks, one with the Stop and Think aid and one without, must be revisited by future research.

The current study also contributes a new set of tasks for modal elicitation. The tasks used herein are novel, non-language based, and therefore non-priming, tasks for the elicitation of modality. They also elicit more types of modality than any of the previous research, allowing for a broader glimpse into the modal use of children. These tasks can be used together with other tasks that evaluate language acquisition to show how semantics compares with other areas of language use. These tasks can also be used as a template for additional tasks to elicit other types of modality to give more insight into the importance of semantics in children. They can also be used as a measure of language production in all populations, especially those with language impairments such as aphasia or autism.
The current study gives evidence that some expressions of modality and expressions of the lower orders of ToM are both available to children as young as six or seven years old, if not before, as claimed by previous research (Coates, 1987; Hirst & Weil, 1981; Wimmer & Perner, 1983; Baron-Cohen, Frith, & Leslie, 1985). This is evidenced by the first graders’ modal production on the epistemic (strong) – stereotypical and dynamic – volitional modality tasks as well as their success on the second order ToM task. While modality and ToM have never before been compared in young children, the first graders in the current study show that modality has a stronger presence than ToM at this age, indicating that modality is acquired prior to ToM. This, too, should be investigated by future research aimed at younger children.

The third graders in this study show that third and fourth order ToM emerges by the age of eight or nine years, but modality remains stagnant at approximately the same level of the first graders. It is not until fifth grade that modality re-emerges and begins to progress, while ToM remains at approximately the same level as the third graders. However, even the fifth graders have mastered neither modality nor ToM. This indicates that both are fully acquired sometime after fifth grade. The interplay between modality and ToM indicates that there is at least a correspondence, but more likely, an interdependence between the two concepts.

Additionally, the poor pass rate of ToM Task 4a together with the high success on ToM Task 4b shows that a negative construction in a complex syntactic structure causes processing difficulties above those of just the fourth order ToM. This, too, must be revisited by future research for a complete evaluation.

Finally, this study shows that modality has a stronger presence in the younger participants than ToM. If propositional attitude verbs are modalized, then it is necessary to have access to modality before propositional attitude verbs can be used. Therefore, this study gives credence to
the theory that propositional attitude verbs, like those used to express ToM, are modalized, as proposed by Hegarty (2006). Furthermore, the interdependence between the two also supports the theory that both propositional attitude verbs and modality call for an analysis using modalized dynamic semantics.
References


Appendix 1 ToM Tasks

ToM Task 1

This is Sally. This is Ann.

Sally has a ball. She puts it into her basket.

Sally goes out for a walk. Ann takes the ball out of the basket.

Ann then puts the ball in the box.

Now Sally comes back. She wants to play with the ball.

Where will Sally look for the ball?
Theory of Mind Task 2

Johnny and Bob are best friends. They really like playing football together. Johnny and Bob both want to play on the school football team. The school football team plays every Monday after school. Johnny thinks that he is not as good at football as Bob is. He thinks that the football coach is more likely to pick Bob for the football team, but the football coach thinks that both Johnny and Bob are good football players and he wants them both to play on the school football team. The coach knows that Johnny doesn’t think he will get on the team.

Memory questions:
(a) What day does the football team play?
(b) Are Johnny and Bob brothers or best friends?

ToM Level 2:
(a) Who does Johnny think the coach wants to play on the team?
Theory of Mind Task 3

Mrs. Smith’s class was having a spelling test on Friday. Mrs. Smith, the teacher, told all of the children to work really hard. Hard work meant that they would do really well on the test. Kristy wanted to do well. She wanted to please her mom. She learned all the words that she knew would be on the test. When Kristy went into class on Friday, she told Mrs. Smith that she had been learning the words all week so that her mom would be happy with her test score. When the spelling test started, Mrs. Smith turned to James first. James was a friend of Kristy, but sometimes he was rather lazy. “James,” said Mrs. Smith, “How do you spell balloon?” James had not been learning his spelling words. He could not remember how to spell balloon, but he did remember that there was a poster in the classroom that had balloons on it. He knew the word “balloon” was written on that poster. The poster was behind Mrs. Smith. She could not see it. James cheated and spelled out the word “balloon” from the poster - b-a-l-l-o-o-n. Mrs. Smith said, “Well done, James, that’s correct.”

Memory questions:
(a) Did Kristy work hard for the spelling test?

ToM Level 3:
(a) Does James think that Mrs. Smith believes that he knows how to spell “balloon”?
Theory of Mind Task 4

Sarah and Joe are in the same class at school. Sarah and Joe often sit next to each other. Their teacher is Mrs. Brown. One day, Mrs. Brown suggests that Sarah and Joe should bring a video into school to watch with the other children as a treat for being good in class. Mrs. Brown also says to them: “Make sure you bring in something really funny that I will like too!” Sarah’s favorite videos are cartoons. Joe’s favorite videos are adventure films. Which will it be?

Cartoons or adventure films? Joe says to Sarah: “We just can’t decide so I think that we should take in the film that Mrs. Brown would like. Sarah, do you know which Mrs. Brown would like best?” Sarah thinks for a minute. She has no idea which film Mrs. Brown would like! But Sarah decides to tell Joe that she knows that Mrs. Brown likes cartoons best. Sarah thinks that this will make Joe decide to take cartoon videos to school. Joe listens to this and then Joes says: “We will take in a video of cartoons then.” So Sarah gets to enjoy her favorite cartoons!

Memory questions:
(a) Which kind of film does Sarah like better: adventure or cartoons?
(b) Does Sarah know what kind of film Mrs. Brown likes best?

ToM Level 4:
(a) Does Sarah hope that Joe would know that she didn’t know what Mrs. Brown wanted?
(b) Does Sarah hope that Joe would believe that she knew what Mrs. Brown wanted?
Appendix 2 Modality Tasks

Modality Task 1a

This is Tommy. That is Tommy's cat in the tree. See the ladder, how short it is? Why is Tommy sad?
This time the ladder is much longer. Why is Tommy happy?
Modality Task 2

What does it mean when there are dark clouds in the sky?
How come sometimes you bring a jacket to school even though it’s warm outside?
Modality Task 4

Pretend that you are a dentist. What do you say to someone that has dirty teeth?
(5a) See the umbrella in the tree. How did it get there?
(Wait for child’s response)
(5b) What’s another way for it to get there?
Appendix 3 ToM Results

First Grade

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<tr>
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<th>ToM 3 - balloon</th>
<th>ToM 4 - video</th>
<th>Sex</th>
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## Third Grade

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Appendix 4 Modality Results

Modality First Grade

1.  female
   1a  cuz the ladder’s not long enough
   1b  cuz the ladder’s tall enough
   2   it’s about to rain
   3   cuz its kind of cold
   4   you have a cavity
   5a  it blew away
   5b  it got stuck

2.  male
   1a  he wants to get his cat out of the tree
   1b  now he can get his cat down
   2   it’s gonna rain
   3   because sometimes they’re rain jackets
   4   brush your teeth better
   5a  somebody used the ladder
   5b  throw it in the tree

3.  male
   1a  because the ladder’s too small and he can’t get his cat
   1b  because he has a lot bigger ladder
   2   it means it’s about to rain
   3   because if it rains you won’t get wet
   4   you need to brush
   5a  maybe somebody was up there and they were playing with the umbrella up in the tree
   5b  somebody threw it up there

4.  male
   1a  because he can’t get to play with his cat
   1b  because he can reach her and get it down from the tree
   2   it’s gonna rain
   3   because they have hoods and it keeps you dry if it’s raining
   4   to brush their teeth
   5   because the wind blew it
   5b  because a person could put it up there

5.  female
   1a  because he can’t get his cat down
   1b  because he could get his cat
   2   it’s gonna rain
   3   because it might rain or it might get colder
   4   you are not brushing your teeth well
it could have blown up there or somebody could have put it up there

female
1a because the ladder isn’t long enough
1b because he can reach the cat
2 it’s gonna rain
3 it might get colder
4 you haven’t been brushing your teeth
5a the wind blew it in the tree
5b a person let it go while the wind was blowing

female
1a because his cat is stuck in the tree and the ladder’s too short for him to be able to get the cat
1b because he can reach the cat
2 it’s about to rain
3 because it may get cold
4 you need to clean your teeth
5a maybe the wind blew it
5b I don’t know

male
1a because his cat is high in the tree and the ladder doesn’t go up to where his cat is
1b because it’s really really close to the cat and it has more steps
2 it’s gonna probably rain
3 because it might turn cold
4 you need to floss and brush your teeth more
5a the wind blew it up
5b somebody could have threw it up

male
1a because he can’t get his cat down
1b because he can get his cat down
2 it’s about to rain
3 so you don’t get rained on
4 to brush their teeth
5a the wind blew it up there
5b somebody could have put it up there

female
1a because his ladder’s too short to reach the cat
1b the ladder is long to reach the cat
2 it’s gonna rain
3 because it might get cold
4 you need to brush your teeth more
it blew out of someone’s hand, maybe
yes

male
because he can’t reach his cat
because he can reach his cat
it’s gonna rain
because it might be rainy
you need to brush your teeth for two minutes
it flew or somebody put it up there
no

male
because he can’t reach his cat
because he can reach his cat
it’s about to rain
because sometimes you just like wearing a jacket
start brushing more often
the wind blew it
someone put it up there

female
because he can’t get the cat
because he could get the cat now
it’s about to rain
because it could get cold
you need to brush your teeth
it was windy and it flew up in the tree
somebody climbed the tree and put it up there

female
because the ladder’s short and he can’t get his cat
because the cat can go down the ladder
it’s gonna rain
because it still could rain
you have dirty teeth
the wind blew it
someone could put it up there

female
because the ladder’s short and he can’t get to his cat
because he can get to his cat
it’s gonna rain
because you never know when it’s gonna rain or get cold
you might get a cavity
the wind blew it in the tree
5b somebody might have threw it up in there

16 male
1a because he can’t reach his cat
1b because he can reach the cat
2 it’s gonna rain
3 because if it’s cold
4 you need a filling
5a the wind took it up there
5b probably it’s stuck there

17 female
1a cuz the ladder doesn’t reach all the way up to the cat
1b cuz the ladder’s longer and he can reach his cat better
2 that it might rain
3 cuz it might rain
4 you need to brush your teeth better
5a the wind blew it up there
5b somebody might have put it up there

18 female
1a because he can’t reach his cat
1b because it’s bigger and now he’ll be able to reach the cat
2 it’s gonna rain
3 because sometimes it can get chilly during the day
4 to brush them better
5 somebody might have been using it and the wind probably blew it away
5b no answer

19 male
1a because his cat’s in the tree and the ladder’s too short for him to get it
1b because he’s big enough to reach the cat
2 it means that it’s about to rain
3 because it might start getting cold
4 brush your teeth everyday
5a maybe the wind blew it up there
5b maybe someone threw it up there

20 male
1a because the cat’s up in the tree and he can’t get it out cuz the ladder’s short
1b because the ladder’s big enough
2 it’s gonna thunderstorm
3 cuz sometimes in the morning it gets cold and sometimes the afternoon gets colder
4 you have to get a gold teeth
5 maybe because the rain with the wind got too big and got stuck in the tree
5b maybe someone planted a tree and it got caught in it
21 male
cuz the ladder’s too short for him to get his cat down
1b because the ladder’s big enough for him to get his cat down
2 it’s about to rain
3 cuz it might get cold
4 you have a cavity
5a the wind blew it
5b a kid could have threw it up there

22 female
cuz he can’t reach his cat
1b cuz he can reach it
2 it’s about to rain
3 because it might get cold
4 you have to brush them twice a day
5a somebody put it up there
5b someone could climb the tree and put it up there

23 male
cuz the ladder’s too short and he can’t get up the tree
1b cuz the ladder is much longer
2 it’s gonna rain
3 cuz it will rain
4 you have a cavity
5a the blew it it
5b someone might have threw it up there

24 male
because he can’t reach his cat
1b because he can get his cat
2 it’s about to rain
3 it might get cold
4 brush your teeth
5a of course, somebody had stuffed it up there
5b no answer

25 male
because he can’t get his cat down from the tree
1b because now he can get his cat down
2 it’s about to rain
3 because it might rain
4 you need to brush
5a the wind might have blown it up there
5b or someone might have put it up there
26  female  
1a  because he can’t get the cat  
1b  he can get his cat  
2  it’s about to rain  
3  in case it rains  
4  to clean them  
5a  it flew in  
5b  someone put it in there  

27  male  
1a  because he can’t get up there with his cat  
1b  because he can get to his cat  
2  it’s about to rain  
3  it might be cold in the school  
4  brush your teeth  
5a  maybe somebody threw it up there  
5b  it could have blew up there  

28  male  
1a  because the ladder’s too short to get his cat  
1b  because the ladder is longer and he can get the cat  
2  that it’s about to rain  
3  because sometimes it may get cold in the class  
4  brush your teeth  
5a  when it stormed, the wind of the storm blew it into the tree  
5b  somebody may have put it up there  

29  nobody  

30  female  
1a  because he’s short and the ladder’s too short and he can’t climb to get his cat  
1b  because he’s short and he can climb it and get the cat  
2  it’s gonna rain  
3  because it’s a rain jacket sometimes and when it’s raining you can wear a rainjacket  
4  you need to start brushing  
5a  the wind  
5b  somebody could’ve threw it up in the tree  

31  female  
1a  because he can’t reach to the cat  
1b  because he can reach the cat  
2  it’s getting ready to rain  
3  because it could get cold  
4  to brush their teeth a lot  
5a  maybe the wind was blowing hard and it got stuck in the tree  
5b  no answer
32  female
1a  because he can’t climb up and get his cat
1b  because then he can get to his cat
2   it’s gonna rain
3   because maybe it’s gonna rain
4   clean your teeth
5a  someone put it up there
5b  throw it up there

33  male
1a  because his cat’s stuck in the tree and the ladder’s not tall enough
1b  because the ladder can reach to his cat
2   it’s about to rain
3   because it’s gonna rain
4   clean your teeth
5a  it blew up
5b  no answer

34  male
1a  because the cat’s in the tree
1b  because the cat can get down
2   it’s gonna rain
3   it might get cold
4   brush your teeth more often
5a  someone threw it up there
5b  the wind blew it up there

35  female
1a  because the ladder’s not long enough to reach his cat
1b  because he can reach the cat
2   it’s gonna rain
3   because in case it rains
4   always clean your teeth
5a  maybe it flew up from the car
5b  could be that it was stuck there

36  female
1a  because he can’t climb up to get his cat
1b  so he can reach his cat
2   it’s gonna rain
3   because it might be a rain jacket
4   brush your teeth
5a  probably the wind blew it up there
5b maybe that could be a tree house and someone brought an umbrella up there and they forgot to take it down

37 male
1a because the ladder’s too short
1b because the cat can get down from the ladder
2 it’s gonna rain
3 inaudible
4 brush your teeth
5a the wind blew it
5b somebody could’ve maybe climbed up the tree and left it there

38 female
1a because the ladder’s too short and he can’t get his cat
1b because the ladder’s longer and he can get his cat
2 it’s thundering and raining
3 maybe the classroom might be cold
4 you need to brush your teeth more
5a maybe it was really windy outside and someone was holding the umbrella maybe not tight enough and maybe it flew up in the tree
5b I don’t know

39 female
1a because his ladder’s too short to get his cat out of the tree
1b because it’s long enough to reach his cat
2 that it’s gonna be raining
3 because in the middle of the day or something or in the afternoon or something you would need it
4 keep brushing your teeth
5a the wind blew it
5b someone could climb up and put it up there

40 female
1a because he can’t get his cat because the ladder’s too short
1b because it’s long enough to reach his cat
2 it’s gonna rain
3 it might be windy
4 brush your teeth more
5a the wind blew it up there
5b a windy storm

41 male
1a because if he get on the ladder he still don’t reach
1b because he is much bigger and (inaudible) and be able reach his cat now
2 it’s about to rain
3 because it’ll be cold inside maybe or it might get cold
4 you need to brush your teeth
5a it got blown away
5b someone could have put it up there

42 female
1a because the ladder’s not big enough to get the cat
1b because the cat can come down
2 it’s gonna rain
3 in case it rains
4 brush your teeth
5a I don’t know

43 male
1a the ladder’s not long enough
1b because he can get the cat because the ladder’s longer
2 it’s gonna rain
3 it might be raining
4 brush them good and get all the plaque out
5a maybe the wind blew it maybe
5b or someone …or something…and got stuck (inaudible)

44 male
1a because he can’t reach his cat
1b because he’s glad the ladder goes up to his cat and now he can get his cat
2 it’s gonna rain
3 cuz it blocks the sun from you
4 brush your teeth twice a day
5a the wind blew it
5b somebody could put it in there

45 female
1a because he can’t get up to his cat
1b because he can…he can (inaudible) ladder to reach his cat
2 it’s gonna rain
3 because it might rain
4 brush your teeth
5a I don’t know

46 male
1a because the ladder’s too short to reach him, the cat
1b because the ladder’s long enough
2 it’s about to rain
3 it could rain or get cold
4 brush ‘em
5a maybe someone left it outside and a storm blew it away
5b someone could leave it up there
female
la because the ladder is not long enough to get his cat out of the tree
lb because it’s longer and he can get his cat
2 that it’s raining or it’s about to rain
3 just in case it’s cold
4 brush your teeth and gargle
5a maybe somebody was holding it and they accidentally let go and it flew in the tree
5b maybe it was left outside and it was really windy that night and it blew in the tree

female
la because his cat’s all the way up here and his ladder’s too short to reach it
lb because the cat’s up there and the ladder’s a little bit longer
2 it’s about to rain
3 it could be cold inside
4 you need to brush your teeth some more
5a by the wind blowing it up there
5b somebody could put it up there

female
la because the ladder’s so short and he can’t go all the way up and get his cat
lb because since the ladder is longer he could climb all the way up and get his cat
2 that it’s about to rain
3 just so you can be cozy
4 you need to brush your teeth
5a whenever it was really windy the wind blew it in the tree
5b someone could just pick it up and sort of throw it in the tree

female
la because the ladder’s too small and he can’t get all the way up to his cat and he wants the cat to get out of the tree but he can’t…
1b because he could climb all the way up the stairs because he’s like this big and he just climb up the stairs and get his cat like really easily
2 it’s going to rain
3 in case it does get cold
4 you would tell them when to come over and …
5a maybe it was like sitting on the floor and a whole bunch of wind came up and blew it up in the tree
5b I don’t know any other ways
Modality Third Grade

1. female
   1a he isn’t able to get his cat
   1b because now he can reach his cat
2  it means that it’s gonna rain
3  because it might get colder
4  you need to floss more and brush
5a it got there when the wind blew
5b someone could have throw it up there but I would probably think that the wind blew it

2  male
   1a because he can’t get to the kitten
   1b because it’s longer and he has enough space to get his kitten
2  it’s gonna rain
3  because it’s probably cold in the classroom
4  brush your teeth day and night
5a it probably blew away
5b someone probably…probably a hurricane picked it up and blew it

3  female
   1a because he can’t get his cat if the ladder’s too short
   1b because if the ladder’s longer then he can get his cat down
2  it’s about to rain
3  because you thought it would be cold or it might cool out
4  brush your teeth more
5a either somebody put it in there or it flew in…the wind blew
5b maybe a tornado came and it got stuck in the tree…somebody was using it as a kite

4  female
   1a probably because he can’t reach the kitty because right here and he probably can’t climb up unless he’s a really good climber
   1b because now he can climb it and get his cat
2  it’ll rain
3  because sometimes it might turn colder later in the day…like somedays at school in the morning it’s cold and in the afternoon it gets really hot
4  you need to brush more and floss
5a somebody was holding it when it was raining and it was really windy kind of and a hurricane came and blew it into the tree
5b some babies like to mess around and stuff and a baby could accidentally throw it into the tree

5  female
   1a because the ladder’s so short and he can’t…and he needs this…and he can to reach his cat
   1b because he can climb all the way up and get his kitten
it will rain
in case it's cloudy you don’t know if it’s gonna rain or not or if it gets cold
you better brush
the wind blew it
no answer

male
because the ladder’s short so he can’t get his cat out
because the ladder’s longer so he’ll be able to get the cat out of the tree
it means it’s about to rain
inaudible
go brush your teeth
it might have been (inaudible) probably blew it into the tree
someone might have put it up there

female
because he can’t reach up to the cat
because the ladder’s long enough to reach the cat
it’s about to rain
because it might rain
we might have to clean your teeth a little bit more this time because they’re a little bit too dirty
maybe someone climbed up the ladder, they had a ladder and they were sitting in the tree
and they had an umbrella with them and then sat there for a little while and it kept raining and kept raining and they decided to go home and they left the umbrella
maybe…remember when the cat was up there like whenever it was raining when the cat was up there so the guy he’ll bring an umbrella and then he left the umbrella up there whenever he got the cat

female
because he can’t get his cat
because he can get his cat
it’s raining
because it’s cold
let’s give you toothpaste and toothbrush
by the wind
or somebody might have stuck it up there

male
because the ladder isn’t long enough for him to climb up and get his cat
because the ladder’s longer and he can get his dog
that it’s gonna rain…it will rain
in case it’s raining
brush more and brush in the morning and at night
maybe it was very windy and somebody let go of it and it blew into the tree
maybe someone threw it up there
male
1a because he can’t reach his cat with that small ladder
1b because he got a bigger ladder and now he can get his cat
2 it’s going to rain
3 because it might rain
4 brush them every day
5a the wind probably picked it up and took it
5b yes

female
1a because he can’t get his cat
1b so he can go get his cat
2 it’s going to rain
3 because it might be cold inside and it might rain
4 brush your teeth more often
5a somebody let go of it when the wind was blowing and it flew up there
5b maybe somebody put it up there or

male
1a because he can’t get his cat because the ladder’s too short
1b because he can get his cat now because the ladder’s taller now
2 it’s going to rain
3 you’re protecting **** from submit
4 you need to start brushing and here’s a toothbrush and toothpaste
5a the wind blew it
5b somebody could climb up the tree and left the umbrella up there

female
1a because he can’t…the ladder isn’t tall enough to go get his cat
1b because the ladder is taller so he can go get his cat
2 it’s gonna rain probably
3 if it’s cold in the classroom or something…like if it’s like (audible) or something you’ll so that it’s cold in the classroom so you’ll bring a jacket
4 brush better and try to get whatever spots they need to work on
5a it may have flew out of somebody’s hand while they were walking by the tree and it got stuck in the tree
5b if somebody was crazy or they were doing an experiment they climbed up the tree and put it in there

male
1a because Tommy can’t reach the cat
1b he’s happy because the ladder is longer and he can reach his cat
2 it means it’s about to rain or it’s about to thunder or lightening
3 there’s many reasons…one could be that it’s a nice style…two it could be that maybe to you it’s cold…three it could be that you have to you want to carry some things around
you say you need to brush harder and floss harder and I need to do that
probably got there because of wind
well, there’s other ways…maybe someone was climbing a tree and they had an umbrella
with them and they lost it or it could have been someone who threw it

male
because he can’t reach the cat
because he can reach his cat that climbed up the tree

because it’s cold in the classroom
brush your teeth better
somebody accidentally three it up in the tree
somebody was climbing the tree and they forgot it

male
because the ladder’s too short and he can’t reach his cat to get down
because the ladder’s longer so he can grab his cat
that there’s about to be a thunderstorm or a lot of rain
no answer
you might want to brush a little bit more in that area
maybe someone was carrying the umbrella with lots of wind and they accidentally let go
and it blew up in the tree
or if somebody decided to climb the tree and it started raining and they held the umbrella
and they forgot it

female
because he can’t reach his cat
because he can reach his cat
it’s going to rain
because it’s cold in the classroom
to brush their teeth
it flew away
maybe somebody put it in the tree

female
because the ladder isn’t long enough that he can get his cat out of the tree
because it’s longer and he can climb the ladder and get his cat
it’s gonna rain
because maybe in your classroom it might be cold
your teeth need to be cleaned
maybe it was a windy day and it blew up into the tree
yes
female
1a because he can’t reach his cat because the ladder’s too short
1b because he can…because the ladder’s longer and he can reach his cat
2 it’s gonna rain
3 because it might rain
4 clean your teeth
5a the wind had blown it
5b I don’t know

male
1a because he can’t reach his cat
1b because his cat can get down because the ladder’s long
2 it’s probably gonna rain
3 because some jackets kind of also protect you from the rain
4 try to brush your teeth more
5a maybe someone threw it
5b someone could have climbed the tree and put it in there

female
1a because he can’t get his cat because the ladder’s too short
1b because the ladder is long enough for Tommy to get his cat
2 it could be a storm or it could rain
3 because it might be a rainy day
4 we’re gonna have to clean them with Mr. Toothbrush and Toothpaste
5a could be really windy and sometimes whenever I have an umbrella and it’s really windy it goes up and I try putting it back down it might have flew out of someone’s hands and went in the tree
5b you climb up and put it in the tree

male
1a because the cat is way up here and it only goes up half the tree and the cat is way up top
1b because now it goes up to the top and he can…the cat is right there so he can climb up and just grab his cat and go down
2 rain
3 it might rain
4 have you been brushing your teeth?
5a the wind could have took it
5b somebody could have stole somebody’s umbrella, put it up in the tree and they would have been wondering where it was
Modality Fifth grade

1. female
   1a because he can’t…because the ladder’s not long enough so he can get to his cat
   1b because he can get to his cat
   2 it’s gonna rain
   3 the air conditioner’s on in the room and it’s cold in the room
   4 you should brush
   5a the wind blew it up there
   5b somebody could climb the tree and stick it in there

2 female
   1a because he can’t climb up it
   1b because he can get up to his cat
   2 it’s about to rain
   3 in case it rains …(inaudible)…or if you just want to wear it
   4 you need to brush…(inaudible)
   5a it was blown it
   5b someone was probably walking with it (inaudible)

3 male
   1a because the ladder’s not big enough for him to get to the cat
   1b because he can climb up the ladder to save his cat
   2 most likely it will rain
   3 maybe you like the feel of the jacket
   4 they should brush their teeth and they should floss it also
   5a the wind might have taken it and put it in the tree
   5b somebody might have put it in the tree

4 female
   1a because it’s too small
   1b because he can get to his cat
   2 it might rain
   3 because it might be cold in the classroom
   4 tell them that they need to brush their teeth more and maybe use mouthwash or
   something
   5a the wind could have blew it up and it landed in the tree
   5b someone put it up there

5 female
   1a because the ladder isn’t tall enough to reach his cat
   1b because it’s long enough to reach the cat
   2 it’s about to rain
   3 because it’s raining
   4 you need to brush your teeth
   5a someone let go of it and it flew up there
people were climbing in a tree and they had an umbrella

female
1a because it’s not tall enough to get his cat
1b because it’s tall enough to get his cat
2 it might rain
3 well, um, when you’re at school the skies might get dark and so if you have a jacket in your backpack, when you go home, if you go to UMC, like aftercare, when you walk over there you won’t get wet because you have a jacket
4 you need to brush your teeth
5a maybe somebody let go of it and the wind from a storm brought it there
5b maybe someone played a prank on someone

female
1a because he can’t get up to the cat
1b because now he can get to his cat
2 that it’s going to rain or storm
3 because it might rain
4 brush your teeth
5a it blew in there
5b well it could have…somebody could have put it up there because there’s a treehouse up there

female
1a because he can’t reach his cat
1b because he can reach his cat
2 that it’s going to rain
3 because it might rain
4 to brush your teeth everyday
5a the wind
5b someone could have put it up there

female
1a because he can’t get his cat out of the tree
1b so he can get his cat down
2 it’s gonna about to rain
3 it might be cold in the building
4 to brush ‘em
5a it probably blew up by the wind
5b someone might have climbed up and put it in the tree

male
1a because the branches start there and they always say don’t step on the top rung and he can’t reach it
1b because he can reach it
2 it’s about to rain
well, I have a different reason then most people but I need to trade it off to my other parent’s house and during the LEAP test I brung it to make a pillow on my desk
brush your teeth, floss your teeth, better get those cavities filled
the wind was going this way and it either flipped the umbrella the thing the umbrella backwards and the person doesn’t have a good grip…up in the tree
someone could have climbed up the tree and put it up there

female
because he can’t get the cat down because the ladder’s too short
because the ladder’s longer and he can get his cat down
it’s probably going to rain
because you just want to wear it, maybe
you should brush your teeth more
the wind probably blew it
someone could have put it in there

female
because he can’t get his cat out of the tree
because now he can get his cat out
it means it’s about to rain
in case it’s cold later
you need to brush your teeth everyday, twice a day
somebody put it in there
somebody could have been holding it and the wind was blowing and it blew in the tree

female
because if he climbed the ladder he still wouldn’t be able to reach his cat
because if he climbed the ladder he could reach his cat
it’s about to rain
because the air conditioning can get cold inside
brush your teeth and you won’t have any more cavities
it was left outside and the wind started to blow and it blew in the tree
it could have rained outside and flew out of somebody’s hand while it was raining

female
because he can’t reach the cat
so he can get his cat down
it’s gonna rain
it might be cold inside
you should brush your teeth
someone could have threw it up there
it could have been really windy and it could have gotten up there if someone let go of it
female
1a because he can’t reach his cat
1b because he can reach his cat
2 it’s gonna rain
3 because it might be cold inside
4 brush your teeth
5a it flew up there, floated up there
5b somebody put it up there
Vita

Danielle Alfandre was required to read “The Language Instinct” in a class required for certification in English as a Second Language. It was then that she discovered linguistics. It was then that she discovered her passion. She immediately transferred to Louisiana State University, as it had the only linguistics program in the area. Since then, Danielle has built the foundation for a long-lasting relationship with her discipline and plans to work on it for the rest of her life.

Always up for a challenge, since starting graduate school Danielle Alfandre has gotten married, purchased a house, adopted her stepson, and had a baby. She has also held a part-time, non-academic job in addition to teaching at LSU. While in graduate school, Danielle was a founding member of the LGSO, the Linguistics Graduate Student Organization, which as a brand new group successfully hosted the first and only Symposium on Louisiana Dialects and Cultures.

Danielle looks forward to a time when she can have only one job, hopefully as a professor in a linguistics department, and can spend some time with her family.