

## Expressions of Modality in Conversational Interaction: A Cognitive Perspective

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### Abstract

This paper discusses the linguistic manifestations of modality in the speech of participants (both native and non-native speakers of English) engaged in solving math problems. It is argued that a focus on modality provides a deeper level of insight into conversational interaction by helping us uncover specific cognitive processes in the minds of individual speakers. Such a level of analysis may not be available in second language research studies that look at dialogic communication as exchange of literal messages between individuals.

### 1. INTRODUCTION

In investigating dyadic conversations in second language acquisition research, a major approach has been to look at interlocutors' expressions *literally*. However, often the problem of "what is being meant by what is said cannot...be stipulated in terms of unequivocal 'literal' meanings of expressions" (Rommetveit 1987:187). The intended meaning of an interlocutor's utterance cannot be decided by the researcher from the outside by exclusively looking at *propositional content* of the interlocutors' utterances. Dialogic communication involves the private world of an interlocutor, in which his or her definition of situation or referential perspective plays an important part. Therefore, it becomes essential to investigate how much a speaker commits to what he says (Palmer 1981). In this context, "propositional attitudes" (Lyons 1977:794), i.e., a speaker's qualification of his commitment to the truth of his or her proposition becomes an important issue. Consequently, in studying dialogic communication, expressions of modality in an interlocutor's speech in terms of propositional attitudes should be investigated. In particular, features of subjective epistemic modality (SEM) in which speaker's propositional attitudes find expression become important.

The purpose of this paper is to discuss linguistic manifestations of SEM in task-based conversations. After introducing concepts about SEM from selected sources, and providing some details about the conversations, the paper analyzes selected parts of the data to show how focus on SEM helps us uncover the interlocutors' respective perspectives. It will show that these perspectives display different cognitive processes in an interlocutor's mind. The discussion then turns to what accounts for such processes (i.e., in terms of semantic and episodic memory). Finally, the paper discusses occurrences of what may be called sensory evidence in the interlocutors' speech as part of SEM.

## 2. CONCEPTS IN SUBJECTIVE EPISTEMIC MODALITY

To begin with, a speaker may present "categorical assertions" which are "straightforward statements of fact" (Lyons 1977:797). In this case, the speaker's utterances are "epistemically non-modal," i.e., the "speaker...is committing himself to the truth of what he says" (797). The following exchange, for example, extracted from a NS-NS conversation in which the interlocutors are trying to solve a math problem, illustrates such categorical assertions:

- [1]      A.    NS(Y): X is less than two...greater than one  
          B.    NS(X): no...it intersects right over here  
                  [*here stressed*]  
          C.    Y: so less than two [*less stressed*]  
          D.    X: it's more than two [*more stressed*]  
          E.    Y: it doesn't intersect over here/  
                  it intersects over here  
                  [*the second here stressed*]  
          F.    X: this one intersects over here [*here stressed*]  
          G.    Y: intersects where?  
          H.    X: right over here

Evidently, both interlocutors have different referential perspectives and the exchange is one expressing disagreement. However, both present categorical statements, statements which are declarative and do not contain any overtly-marked modality feature. Consequently, the interlocutors express unqualified commitment to the truth of their propositions. Their statements, in this respect, are "epistemically non-modal" (Lyons 1977:797).

On the other hand, a speaker's utterance may be "epistemically modal," i.e., "the speaker explicitly qualifies his commitment to the truth of the proposition" (Lyons 1977:797). Thus, for example, one speaker in the following NS-NS conversation, in which the participants are trying to solve a picture puzzle, states the goal of the task as follows:

- [2]            NS(Y): You probably need to arrange the  
                  pictures in the proper order

In this statement, the word probably is crucial. By using this word the speaker expresses his uncertainty in regard to what the goal of the task is. In terms of SEM, he explicitly qualifies his commitment to the truth of his proposition.

In discussing epistematically modal utterances, Lyons distinguishes between "objective epistemic modality" and "subjective epistemic modality." Objective epistemic modality states an "unqualified assertion of the possibility of a proposition," while subjective epistemic modality qualifies "the assertion of the factuality of the proposition" (Lyons 1977:750).

Lyons makes a further distinction between the two kinds of epistemic modality. An utterance showing objective epistemic modality contains, besides an unqualified or categorical "I-say-so" component, an objective "it-is-so" component which is "qualified with respect to a certain degree of probability" (Lyons 1977:800). In other words, "the speaker is committed by the utterance of an objectively modalized utterance to the factuality of the information that he is giving to the addressee: *he is performing an act of telling*" (Lyons 1977:799; italics added). On the other hand, "the very essence" of an utterance showing subjective epistemic modality is "to express the speaker's *reservations* about giving an unqualified, or categorical, 'I-say-so' to the factuality of the proposition embedded in the utterance" (Lyons 1977:799; italics added). Thus, a subjectively modalized utterance is not an act of telling; its "illocutionary force is...similar to that of questions" (Lyons 1977:799-780).

It is in this respect that subjective epistemic modality is relevant for the present discussion. SEM in an interlocutor's utterance draws attention to the speaker's attitude towards the propositional content. Thus, in the example cited above (excerpt [2]), the NS is not so much engaged in the act of telling, i.e., informing, the other interlocutor what the task goal is, but is actually trying to discover what the task goal is. The illocutionary force of probably reveals self-questioning, a knowing strategy on the part of the speaker. Thus, focus on the feature of SEM in his utterance provides insight into this speaker's cognitive state in the specific task.

Important light is also shed on the implications of subjective epistemic modality in Chafe's (1986) study of evidentiality in conversational and written English. Chafe defines evidentiality non-restrictively, i.e., not in terms of evidence per se but broadly in terms of the attitudes of a speaker towards such evidence. Languages, thus, have markers of evidentiality, the linguistic coding of epistemology. In English, such markers are, e.g., modal auxiliaries, adverbs, and miscellaneous idiomatic phrases, etc.

Furthermore, Chafe (1986:263) provides a useful schema in terms of a few notions that illustrate what evidentiality involves and how the different aspects of evidentiality are linguistically encoded. According to this schema, one such notion "can be labeled KNOWLEDGE: the basic information whose status is qualified in one way or another by markers of evidentiality...Knowledge may be regarded by a speaker (or writer) as more or less reliable" (Chafe 1986:262). Thus, for example, in such utterances as "*It's probably a spider*" (263) and "*It might be a spider*" (264), the words probably and might are markers of different degrees of reliability of the knowledge contained in the statement "It's a spider."

Another relevant notion is "MODES OF KNOWING: various ways in which knowledge is acquired" (Chafe 1986:263). Such modes include belief, induction, hearsay, and deduction. Furthermore, each mode of knowing is grounded in a specific source of knowledge. Thus, for example, belief is "a mode of 'knowing' in which concern for evidence is downgraded...[i.e.] belief is always based on something other than evidence alone" (266).

Typical markers of belief in conversational English are such phrases as I think, I guess, I suppose.

Furthermore, Chafe (1986:266) explains that, in contrast to belief, induction or inference is a mode of knowing in which a sense of evidence is perceived by the speaker as important. "English often signals that induction has taken place, without any indication of what the nature of the evidence was" (266). In this case, must marks an explicit sense of induction, indicating a high degree of reliability, and obvious indicates an even higher degree of such reliability.

Chafe (1986:269) continues that yet "another mode of knowing is to invent a model which predicts what will count as evidence. Such reasoning involves an intuitive leap to a hypothesis from which conclusions about evidence can be deduced." Deduction in English is typically marked with such words as should and presumably. They express a high sense of reliability. On the other hand, a lesser degree of reliability is encoded in such deductive markers as can and could. Chafe points out that would is a special kind of deduction marker; it expresses a "special kind of hypothetical knowledge [in which] an outcome is predicted contingent on an unrealized condition" (269).

In short, these concepts comprise the framework for SEM within which this paper organizes its discussion in the following sections.

### 3. DATA

The data are taken from task-based conversations involving native speaker (NS) and non-native speakers (NNS) of English as follows: a NS-NNS dyad, a NNS-NNS dyad, and a NS-NS dyad. All the participants were enrolled in an undergraduate mathematics course at a university in the United States. In the conversations, the participants are solving math problems given by their instructor as part of their preparation for a course examination. The conversations were videotaped and later transcribed. Selected parts of these conversations are used in this paper for discussion.

### 4. DISCUSSION

The following excerpt [3] shows the opening of the conversation and a partial discussion by the NS-NNS dyad solving the first problem assigned by the instructor:

- [3]    A.    NNS(X): Do you want to talk about it?  
      B.    NS(Y): Yeah...I guess  
      C.    X: ok [pause] I guess....like...we have...like this  
            Y equal...X...plus...B..or whatever/..  
            you have the beginning  
      D.    Y: right...yeah  
      E.    X: I...plug...those points in it

- F. Y: uh...first...you want the slope of the line..right?/  
so...you have to find...uh...M
- G. X: right
- H. Y: which is especially what you need../  
like...[*now writes*]  
Y...two..minus..Y..one...three..four...minus.../  
this is...two minus negative...three [*mutter*]
- I. X: What I do is...I just...I plug those points in it..  
[*tone becomes low*]...and...uh  
[*pause...mutterings*]  
[*now tone rises*] what I do is...like this../  
and..you can solve...  
like...I have two equations
- J. Y: uh..um
- K. X: and
- L. Y: you just take either point...it doesn't matter
- M. X: wait...oh..no..I just plug both of them..  
both points... in.. the..
- N. Y: but one set of points..not both
- O. X: this one is the point... this one
- P. Y: uh.um
- Q. X: two point...two..and..minus..three
- R. Y: uh.um...oh..this is two
- S. X: uh.um
- T. Y: but..you're assuming...this is the slope
- U. X: no..no..this is... I just assume... this is a point/  
[*pause*] this equation means...  
when Y is minus negative three...two...OK  
..multiply two..like..mul..uh..multiply two X  
plus B...should be mi.. negative three  
[*mi for X is the first syllable for minus*]  
that's what it is..  
so I can plug them in..it

The opening of the conversation contains an important indicator of propositional attitude on the part of both interlocutors. Speaker X (the NNS) and speaker Y (the NS) use the same belief expression I guess in utterances (B) and (C). They, thereby, explicitly qualify their commitment to the truth of their respective propositions. However, their utterances are differentiated in terms of form-function relationship. In (B), Y's expression is uttered as a response to X's inquiry in (A). In this respect, the underlying structure of Y's I guess may well be rendered as I guess so in which the so refers to the previous discourse (i.e., X's utterance). The expression thus does not refer to math problem solving per se, but to the desire, or lack of desire, for starting a conversation. It occurs as a metacomment, showing the speaker's qualification of the activity of talking itself.

On the other hand, X's I guess in (C) refers to the math problem itself in that she presents an equation which serves as the beginning point for solving the math problem. Thus, the underlying structure of her I guess is something like I guess that in which the that component refers to the proposition that follows the proposition contained in this, and

elaborated subsequently in Y equal...X plus. In this respect, X's I guess refers to how she perceives the beginning of the solution to the specific math problem. Thus, it qualifies the propositional content and reveals her propositional attitude.

In short, Y's I guess and X's I guess are functionally different. The same belief expression has different cognitive functions, showing the complexity of form-function relationship. By using the same expression the interlocutors do not exchange information but display their functionally distinguishable propositional attitudes.

Significantly, focus on SEM in the speech of these interlocutors, as shown in the above excerpt [3], reveals their respective cognitive processes while solving math problems. It should be mentioned that the interlocutors adopt two different approaches towards the first math problem. Their conversation, as particularly indicated in the exchanges in utterances (E) and (F), (H) and (I), (L) and (M), and (T) and (U), brings out a sense of basic difference between them. In fact, the conversation shown in [3] appears as a kind of debate between their different approaches. In the context of the math problem they are solving, as explained by the math professor who was involved in the study in terms of designing the task and reviewing the data, the difference may be labeled *slope vs. equation* (Wenger, personal communication). At one point in the conversation, speaker Y makes this difference explicit, as follows:

- [4]     A. NS(Y):    well...I was going to find the slope first  
         B. NNS(X): uh.um  
         C. Y:        then...keep finding the equations...

The difference between the NS's focus on slope and the NNS's on equation is as follows. Both interlocutors solve the problem correctly. However, they approach the same problem differently. In math terminology, the NS determines the slope using the two-point method for determining the equation of a line. The first step in this method is to determine the slope by using the coordinates of the two given points. On the other hand, the NNS begins to determine the slope by using the slope-intercept form of the line. However, she then decides to use the coordinates of the points given to determine a system of two equations in two unknowns (variables). Then she proceeds to determine the co-efficients of the line desired.

In this context, the NS follows a standard practice taught in American textbooks and classrooms. On the other hand, while the NNS's use of the slope-intercept form is a standard approach taught in American text books and classroom, her focus on the equations involving two unknowns is not typically emphasized in American math education at this level of undergraduate studies. In this regard, the NNS shows considerable expertise in math. It shows she possessed a strong background in the content area.

These differences may well be attributable to the interlocutors' different educational backgrounds (i.e., an American classroom situation for the NS and a Japanese classroom for

the NNS). In fact, in a post-task interview, speaker X (the NNS) pointed out that she was attempting to solve the problem according to her past math learning experience in her home country. Thus, the discourse in [3] shows that the interlocutors, instead of exchanging information and thereby solving the problem jointly, actually display their different referential perspectives rooted in their respective educational backgrounds.

Within the framework of their different approaches, the interlocutors follow distinct, although not contrasting, cognitive processes, as shown by the linguistic features of SEM in their utterances. Speaker Y shows a sense of induction in (F), in which the expression have to seems to have the force of must. It indicates that her mode of knowing has a high degree of reliability in her referential perspective. This heightened sense of reliability may ensue from her certainty in regard to what the math problem demands (see 'F' and 'H'). In fact, the question posed in the first problem is as follows: "Find the slope of the line containing the points (2,-3) and (-4,2)." Thus, by focusing on "slope" from the very beginning, she feels she responds directly to what she perceives the problem demands.

On the other hand, speaker X expresses a different cognitive process. Her I guess in (C) expresses some belief on her part (in Chafe's term). It indicates that at this point she is not sure about the evidence she has in mind. She thus *explores* to find the required solution to the problem. Her orientational ok and the pause before I guess are further indicators of the process of exploration. Subsequently, her use of can in you can solve (I) and should express a deductive reasoning process (in Chafe's terms). These markers of evidentiality indicate that she builds some hypotheses in her mind that predict the outcome, i.e., the solution to the problem based on her strategy of using 'equation'.

This linguistic evidence of distinct cognitive processes implies that the interlocutors by their act of speaking are not so much exchanging information, i.e., sending and receiving messages, as they are displaying their own individual cognitive approaches to the particular math problem. The interlocutors maintain two distinct referential perspectives.

The use of SEM occurs more significantly in the following excerpt [5] in which the interlocutors (the NS-NNS dyad) discuss their selection of a particular answer to another math problem (Problem # 3) in the given assignment:

- [5]    A. NS(Y):    this should be like this  
       B. NNS(X): yeah  
       C. Y:    so the answer would be negative two...  
              and five  
       D. X:    um... I forgot how to read those/  
              do you remember that? [laughs a little]  
       E. Y:    oh.. I got this wrong on last exam/  
              I think.. that.. uh.. it would be this...  
              because it's  
       F. X:    this one... I guess this is... like  
       G. Y:    it's like five.. and above.. and negative two...

- and.. below
- H. X: uh.um... is it.. should be like that..
- I. Y: I think so.../  
because I remember... on the exam  
I... put.. like that.. and.. I had the right  
answers../  
but I just didn't have it in the right form..  
so I think
- J. X: um.. but we can do it.../ um.. example..  
maybe we can plug.. uh.. ten.. or something../  
you know what I mean... like.. when X is ten
- K. Y: yeah
- L. X: um.. this equation.. is like.. hundred.. minus  
thirty... minus ten.. is um.. sixty?
- M. Y: sixty..
- N. X: so that's no true.../ that's not zero/  
so X shouldn't be over five/  
you know what I mean... like/  
you said that's like over five..  
and less than negative two/.../  
then what I did was... I plugged..
- O. Y: um
- P. X: a number
- Q. Y: this is even like...negative... I don't think...  
I think... this is the right answer...
- R. X: which one.. B?
- S. Y: yeah
- T. X: yeah... I guess so.../  
I don't... I don't remember which has... um...  
includes the number.. do you remember this  
one... and this one
- U. Y: no... I don't
- V. X: I don't... I just don't [*both laugh*]  
I guess B is
- W. Y: ok.. that's what I would say... is the right  
answer...

There are several occurrences of belief expressions, (i.e., I think and I guess) on the part of both speakers. These expressions have the effect of explicitly qualifying the propositional content of their utterances. Both also express the deductive mode of reasoning by using should, can, and would variably (see 'H,' 'J,' 'N' for speaker X, and 'A,' 'C,' 'E,' 'W' for speaker Y). As already mentioned, according to Chafe (1986:269) such deductive reasoning involves "intuitive" leaps to hypotheses on the part of the interlocutors, from which conclusions are deduced.

However, once again, similar expressions can be functionally differentiated, similar to the differentiation uncovered in [3,A] and [3,B]. In the above excerpt [41], in fact, similar expression in the speech of the same speaker and within the same discursive environment can be functionally differentiated: speaker X's I guess in (T) and (V). While in (T) the expression



refers to the previous discourse, in (V) it refers to the proposition that follows. Thus, in (T) it may be categorized as a meta-level use; in (V) it is related to problem solving itself.

In terms of the dynamic nature of the form-function relationship, the use of would on the part of the NS in [5,C] and [5,W] is particularly revealing. As already mentioned, Chafe (1986:269) points out that this modal expresses a "special kind of hypothetical knowledge [in which] an outcome is predicted contingent on an unrealized condition." In the discursive environment of the above excerpt, however, Chafe's definition does not apply to the NS's use of would. Would can still be used following conditions which may very well have been realized. Evidence for this exception to Chafe's definition is found in speaker Y's utterance [5,A]. The utterance in its use of should indicates that the speaker has gone through a process of deductive reasoning and reached some conclusion. In other words, the conditions embedded in her reasoning have been realized. Her would in (C) occurs following the realization of conditions, showing that Chafe's definition is not always true. This implies again that the form-function relationship arises from specific person/task interaction.

Y's would indicates some degree of reliability in the speaker's mind, evidently due to deductive reasoning, indicating certainty of knowledge. Nevertheless, it is, what may be called, 'softened' certainty. In this respect, the use of would has the effect of qualifying the propositional content. It expresses the speaker's propositional attitude. As discussed below, this attitude eventually arises from the speaker's reliance on episodic memory.

## 5. SEMANTIC AND EPISODIC MEMORY

The discussion so far has shown that modality/evidentiality marking uncovers the respective cognitive processes of the interlocutors during the activity of math problem solving. This section turns to what accounts for such processes, i.e., in terms of semantic and episodic memory. Accordingly, this subsection presents evidence for such types of memory.

Both interlocutors engage in, what may be called, acts of remembering or forgetting, as shown in [5]: X's utterances (D), (T) and (V), and Y's utterances (E), (I), and (U). These utterances show the interlocutors depend on memory to weigh evidence for solving the math problem. However, there are very significant differences between the two interlocutors in terms of reliance on memory. Speaker X states that she has forgotten how to read properly certain mathematical symbols. In other words, in the multiple choice question (which was given in the math problem), three of the five given answers are shown as follows: b. (-2,5); c. [2,-5]; and d. [-2,5]. As shown at the end of excerpt [5], she chooses answer 'b'. However, since she is not sure how to read the mathematical implications of "( )" vs. "[ ]," her choice of

"b" is not based on any direct, clear evidence. The evidence is evaluated within the context of her reliance on memory. Thus, the choice is the result of guessing. In terms of evidentiality, speaker X's use of I guess indicates that her choice of the answer is based on some belief in which clear evidence is not the sole determinant.

On the other hand, speaker Y's acts of remembering or not remembering are based on, what may be called, episodic memory, as clearly shown in her utterances in (E) and (I). Her choice of the answer is based on her knowledge of some evidence in the form of recall from past events. In this context, her use of would (W) softens or qualifies her commitment to the truth of her proposition. Such qualification reveals that her knowledge for solving the math problem is based on evidence that exists in episodic memory. She is not really solving via reasoning but via memory of past experience.

In this regard, the concluding part of the conversation in the discursive environment of excerpt [5] is significant. Both speakers seem to agree as to their selection of the answer. In terms of an information exchange perspective, it may be said that the interlocutors negotiate meaning and resolve their differences. However, the respective cognitive states of the individual interlocutor are more significant. Thus, speaker X finally qualifies her prepositional content B is (V) with I guess after failing to remember something that would have constituted direct evidence. Similarly, speaker Y relies on episodic memory (U) and qualifies her prepositional content with would (W). Thus, with reference to the dialogic exchange in utterances (V) and (W), while there is agreement between the interlocutors about which answer to select, there is a noticeable lack of unqualified commitment to the truth of their individual propositions.

At this point, to explicate further the significant differences between the interlocutors in terms of their reliance on memory, the discussion turns to other important aspects of the conversation, related to the interpersonal dynamics in this math conversation.

In this conversation, the NNS speaker seems to dominate the discussion, both in quantity (i.e., how much she speaks) and quality (how well she demonstrates her math skills). The following rather lengthy excerpt [6] illustrates the quantity and quality of her speech compared to her native-speaking counterpart:

- [6]    A.    NNS(X):    what I need is (*low tone*)/  
                              (*now tone rises*) in there...like...(*pause*)/  
                              there is some five (*questioning tone*)/  
                              no...there is some...minus five/  
                              it goes more than five...right?  
          B.    NS(Y):    uh.um  
          C.    X:    like this?/

- I don't know why do we have to change both...
- D. Y: I don't remember the rules for this
- E. X: but I am sure...when.../.../  
oh...I don't here (*low tone*)  
do I?/.../  
wait...that (*low tone*)  
(*now tone rises*) when they are... less than five  
that's not the answer...doesn't it?  
when those (*pause*)  
that means like...in...like..in..this..  
how do you call...absolute?
- F. Y: uh.um...absolute value
- G. X: absolute value... is... more than five..  
that means... it can be less than negative five..  
right?
- H. Y: right
- I. X: so it can be...less than five (*low tone*)/  
(*now tone rises*) less than negative five..right?
- J. Y: ok..yeah
- K. X: so the... (*tone falls now*)  
should be...uh/.../  
minus two ... X... /  
(*now tone rises*) negative two... X...
- L. Y: two
- M. X: A.../ this is ...plus
- N. Y: plus... yeah
- O. X: and... so... next (*low tone*)/  
(*tone rises*) change direction (*questioning tone*)/  
so it's like... four...
- P. Y: uh..um
- Q. X: why don't we... plug one... one.. just like a  
number... in it.../  
ok...when X is five.. when X is five..  
mi...negative ten... plus three.. is ... seven..  
so that's five... ok?
- R. Y: yeah

As can be seen, there is actually no joint activity going on in terms of solving the problem together. The NS provides minimal responses, showing agreement with the NNS. She (the NS) appears as a mere observer. On the other hand, the NNS does most of the talking and mathematical reasoning. Her speech also shows the occurrence of self-directed, i.e., private speech (E). In this respect, she solves the problem by, and for, herself. Significantly, the we she uses in (C) and (Q) is exclusive and does not necessarily indicate a sense of joint responsibility on her part. In other words, by using the pronoun, the NNS rather than saying you and I seems to be saying I in the presence of you. She thus appears as the problem solver, but the problem solving is self-directed.



(which were checked later) show that while X writes down 'd' as the answer, Y actually writes down 'b'. At least in writing, they choose different answers.

This discrepancy in their written protocols is open to various interpretations. It could simply be that Y makes a slip while writing down the letter. Again, it could be that in her reasoning process, Y settles upon 'b' with a sense of reliability and does not actually agree with X. Another reason could be that she might have already written down 'b' as the answer and did not bother to correct it. Yet another reason could be that she ceded control of the discussion to X and let her decide the answer without taking part in it. In any case, the fact remains that X's search for the correct answer does not end with 'b', while Y's does. In this context, Y's utterances [7,D] and [7,F] seem like appropriate responses, indicating that she comprehends X's messages. However, as the above analysis of the written protocols shows, this is not the case. In fact, no information is transferred or exchanged.

The following excerpt [8] provides further evidence for speaker X's developed mathematical skills. In the discussion on problem #7, she demonstrates that she has a variety of representations at her disposal for solving math problems. Thus, after choosing a specific answer, she goes on to draw a graph to check the answer, as shown in utterance (G). She thus takes recourse to a graphic representation of the math problem:

- [8]    A.    NNS(X):    let me see (*very low tone*)/  
                              what do you have here?  
                              (*Looks at Y's paper*)/  
                              (*Low tone*) two... that's plus nine/.../  
                              (*Tone rises*) here
- B.    NS(Y):    negative four... eleven
- C.    X:    that's like two...minus..four..plus eleven/  
                              that's nine...OK?/  
                              so... should we..
- D.    Y:    negative...all right.. negative two
- E.    X:    uh.um/.../  
                              so that's.../.../ yeah... I guess that's A
- F.    Y:    A is one and nine?/.../  
                              Oh...yep.. don't mind
- G.    X:    uh... I mean... we can solve.../  
                              solve like...draw like the graph...like..uh.../  
                              we already know that Y is.../  
                              (*tone falls*)..uh..how do you call it?...Y axis?
- H.    Y:    uh.um
- I.    X:    is/.../no...Y interrupts/  
                              I don't remember those word../  
                              is eleven...when X is... zero.. Y..is definitely  
                              eleven.. right?
- J.    Y:    uh.um

Speaker Y (the NS), on the other hand, shows a strong reliance on episodic memory during the discussion of the different problems, as already shown in excerpt [5]. In the following excerpt [9], which deals with problem #6, her reliance on such memory becomes even more explicit:

- [9] A. NS(Y): all right...uh.../.../ well...you can have  
 B. NNS(X): what did you do?  
 C. NS(Y): I'm doing....  
           *[Both laugh]*  
           ok...ok...you can have a zero...or  
 D. X: wait..uh  
 E. Y: or square root  
 F. X: uh.um  
 G. Y: so you just.../.../whatever makes this zero  
 H. X: *(pause)* uh.um *(low tone)*  
 I. Y: so  
 J. X: uh..wha..what do you mean?/  
           we...we can have negative *(stressed)*  
 K. Y: yeah...you..  
 L. X: yeah..so we can have/  
           what makes ... four..X..square..minus .. nine/..  
           zero  
 M. Y: right...whatever is going to make it ... zero  
 N. X: so..uh..we can have..two..X..minus..three....

The NS in the above excerpt adopts a standard approach learned in a math classroom situation: "You have to check two things: radicals and quotients" (Wenger, personal communication). However, as pointed out, radicals are not relevant to the question itself. The NS actually recalls fragments from past practice problems in text books. It shows the influence of text book practice in a typical classroom situation. Thus, the speaker's reasoning is heavily dependent on her past practice, not on the problem itself. On the other hand, the NNS (speaker X) in her equation suggested in (L) indicates a sophisticated understanding of the content.

In short, speaker Y tends to rely on episodic memory for solving math problems. Such reliance indicates that in her mathematical reasoning she operates on everyday cognitive levels compared to her non-native speaking counterpart. For her thinking seems to be remembering, i.e., recalling evidence from past events. This accounts for her use of the past tense, as previously shown in [5,E] and [5,I]. It is a strategy often used in everyday cognition and a dominant form of thinking in early cognitive development. In speaker Y's case, it reveals a strategy of reaccessing.

Furthermore, speaker Y (the NS) seems to lack the ability to approach the math problems in a decontextualized and principled manner. She seems to be caught by the

immediate context of a specific problem at hand. This accounts for the occurrence of the present progressive in her speech, as already shown in [3,T], [4], and, [9,C]. In the following excerpt [10], the appearance of the present progressive in (N) is significant in relation to the discursive environment of the excerpt:

- [10] A. NNS(X): you know what I mean  
 B. NS(Y): yeah  
 C. X: and... the number... from...that... like.. Y minus..  
     Y.. 2...Y..2 .../ how do you call it?/.. like Y2  
 D. Y: uh.um  
 E. X: minus Y..1  
 F. Y: uh.um  
 G. X: means...we have this/  
     so this is like...X2...minus X1/  
     this is Y... minus... Y/  
 H. Y: wey...  
 I. X: Y.w...minus Y..1  
 J. Y: Y..1  
 K. X: so..what we need is this  
 L. Y: uh.um  
 M. X: so...I don't remember how to call this..rule  
     [*rule stressed*]  
     uh...like/.../  
     the square of this distance...  
     and the square of this distance...  
 N. Y: ok...I'm thinking of a midpoint.../  
     I'm doing the midpoint now..  
 O. X: uh.un  
     [Indicates that Y is on the wrong track.]

The NNS in her utterances (A) through (K) engages in explaining the way the formula is derived as required by the problem (Wenger, personal communication). She grasps the important principles of the formula in question. On the other hand, Y's utterance (N) shows her to be caught by the immediate context of what she perceives to be the problem (a midpoint). However, Wenger (p.c.) points out, midpoint is not relevant to the question, and reference to it may have been triggered by some association in her episodic memory. In the context of the specific problem, she refers to something other than the formula and shows she is having problem in understanding the principles. The use of the present progressive is significant in revealing her cognitive difficulty.

On the other hand, speaker X shows a high level of mathematical reasoning compared to her native-speaking counterpart, as shown in her mathematical resources for solving problems. In the linguistic features of her speech, past tense occurs not as acts of remembering past events but intrinsic to the discourse in reference to the discursive environment of the

conversation itself. Thus, in [5,N], the past tense refers to speaker Y's utterance [5,C]. Furthermore, there are no instances of the present progressive in her utterances.

From this perspective, the nature of memory she relies on seems to be semantic memory. In other words, being a non-native speaker of English, she has not yet fully mastered the English vocabulary for discussing math content. Evidence for this can be found in such instances as [5,D], [5,T], [5,V], [6,E], [7,E], [8,G], [8,I], and [10,M]. On the other hand, as a result of her strong conceptual ability in math content compared to her conversational partner, she is able to control the problem-solving activity. This sense of control is linguistically reflected in the use of tense/aspect and personal pronouns.

On the basis of the above analysis, it may be concluded that accessing of episodic memory in the case of the NS, and semantic memory in the case of the NNS, account for the occurrence of different types of modality/evidentiality. Modality and/or evidentiality marking in the speech of both interlocutors is significant in revealing their respective propositional attitudes and different cognitive processes in math problem solving.

## 6. MANIFESTATIONS OF SENSORY EVIDENCE

In this final section, some other features of modality/evidentiality are discussed. Examples are given from the NNS-NNS and the NS-NS conversations. The following excerpts [11] and [12] are extracted from the NNS-NNS and the NS-NS dyads respectively:

- [11] A. NNS(Y): can we look at text book?  
B. NNS(X): no... I don't think so... no [laughs]  
um... you have text?  
C. Y: I have text  
D. X: me...too!.../I brought  
[pause]  
why don't we skip this one? [laughs]  
E. Y: skip?  
F. X: yeah [laughs]  
next one looks easy  
G. Y: yes  
H. X: ok?/...ok  
[mutters. self-directed.]  
I. Y: I think this one is four?  
[Y is working on the same problem.]  
J. X: you think so?  
K. Y: uh.um...this is like minus two/  
minus two...in...E [Math term]/  
and ... this one .. equal one/  
so....minus two... time... one is minus two.../



- so six
- L. X: minus four
- M. Y: six... and six... plus.. minus two.../  
equal 6.. minus 2... equal four
- N. X: uh.um
- O. Y: I am not sure/ I think it's four
- P. X: It sound right/ it sounds right [laughs]
- Q. Y: ok... let's do the third one
- R. X: ok
- [12] A. NS(X): I don't know how to do it
- B. NS(Y): F..of..G..equals 2.. to the sin..X/  
we've sin X/.../  
so we've to put ....G.../.../  
....I don't understand [laughs]/  
look...you see... I mean... I see it.. I guess/  
because we want..2..to the...sin X/  
we already have a sin X/  
it's in the air/  
it has to be....you plug it in for X/  
you see that/.../it's in the air/..2..to..the X/  
problem number five [laughs a little]/  
do you understand?
- C. X: no
- D. Y: would you be able to do that on the test?/  
would you pick..2..to the X?
- E. X: I'd pick..2..to the X because we just did the  
problem..
- F. Y: would you also pick 2 to the X because it'd be in  
the air?/  
like the thing in the air/  
we already have..the thing in the air/  
we've something/ it's something/  
it's two to the something/  
do you know what I'm saying?  
probably not/  
[pause]  
you can use that scrap/  
and I'll use another paper

There are several cases of modality/evidentiality in these excerpts. However, in the NNS-NNS conversation of particular importance are the occurrences in [11,O] and [11,P]. They occur at a critical point in the conversation, i.e., the moment of answer selection. Speaker Y, who solves and selects the answer, explicitly qualifies her commitment to the truth of her proposition by means of belief expressions. Similarly, speaker X does the same thing by using It sounds right. However, X's use of the evidentiality marker is significant in revealing the nature of the evidence from the speaker's point of view. According to Chafe (1986:267),

sounds indicates sensory evidence, which actually expresses "less than fully reliable" knowledge. In the above instance [11,P], the use of the word shows "a degree of doubt" in the speaker's mind (Chafe 1986:267). This can be explained with reference to the discursive environment of the excerpt, which shows that the speaker wishes to skip the whole problem, while his counterpart continues solving the problem. Thus, when the answer is proposed by her, he just accepts it without full mathematical knowledge of it.

Similarly, in the NS-NS conversation [12], speaker Y's use of I see it (B) is an important marker of evidentiality. It expresses a sense of perceptual knowledge of evidence on the part of the speaker, which, in Chafe's (1986:267) account, implies more reliability than does sounds. As a matter of fact, as the video-taped data show, the speaker literally looks at the space in the top portion of the paper that contains their written protocols. When she says it's in the air, the referent (a math symbol  $\sin X$ ) seems to be located in that space. In this context, the speaker literally sees the referent in front of her. Her heightened sense of reliability arises from this certainty of seeing it and what it means for her. High reliability is further evidenced in such expressions as we already have a  $\sin X$  (B), it has to be (B), and later we already have (F), we've something/ it's something (F).

Speaker Y's choice of certain lexical items is particularly revealing. The speaker draws the attention of her conversational partner to the referent by means of such expressions as the thing, and locates it in the air. As Wertsch (1985:168) points out, an interlocutor's referential perspective in dyadic communication is important in order to understand how an interlocutor categorizes a referent during his referential behavior. In the above instances, speaker Y's categorization of the referent, which is actually some mathematical symbol in relation to the problem, may be seen as non-verbal pointing. The expression the thing does not contain any mathematical information. The speaker does not introduce any mathematical information in his referring expression. Furthermore, the location of the referent (in the air) is in the form of an imaginative term derived from everyday vocabulary, i.e., air represents the space on the piece of paper. In short, the speaker relies on everyday ordinary language, not math-based scientific terminology, to categorize the referent. Such categorization is spontaneous and personally contextualized, not scientifically decontextualized, and implies reliance on everyday cognition and pragmatic modes of speech.

This kind of categorization sheds important light on the question of the NS-NNS distinction. Had the above categorization been found in the speech of a NNS, it would most probably have been called a compensatory strategy on the part of the NNS. In other words, due to his linguistic deficiency, it would have been explained that the NNS takes recourse to simple, everyday vocabulary within his repertoire in order to communicate successfully, i.e.,

he uses something he already knows to compensate for a "gap" in his competence. However, in the above case, the categorization of the referent occurs in the case of a NS. It indicates that the speaker takes recourse to everyday cognition due to cognitive difficulty in the face of a math problem, which they both say, explicitly, that they do not understand. In this context, the use of air is curious. It is not a direct reaction to visual stimuli. Such a reaction would have triggered expressions like on top or above. By using air, the speaker reveals a three dimensional image in her mind. Cognitively she accesses an everyday metaphor.

## 7. CONCLUSION

As the discussion in this paper has shown, a focus on modality/evidentiality helps us uncover the cognitive processes of individual interlocutors in dialogic communication. This approach goes deeper than just looking at literal meanings of expressions that has guided much of the research in investigating transfer/exchange of messages between a speaker and a listener. By focusing on expressions of modality, this paper has demonstrated that the linguistic behavior of an individual is significantly related to his or her cognitive processes. Such an approach finds a powerful theoretical support from Vygotskian psycholinguistic theory (Wertsch 1985). However, this theory has not been used as a conceptual framework in this paper.

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