BUCLD 37 Proceedings
To be published in 2013 by Cascadilla Press
Rights forms signed by all authors

Linguistic and Conceptual Representations of Inference as a Knowledge Source

Ercenur Ünal and Anna Papafragou

1. Introduction

During the preschool years, children become increasingly aware of the kinds of experiences that led them to believe or know something. These experiences, which characterize the conditions under which information is acquired, are known as *sources* of knowledge (Johnson, Hastroudi & Lindsay, 1993). The process of attributing a piece of information to a particular source is *source monitoring* (ibid.). In this study, our main question of interest was how preschool children linguistically and conceptually represent different sources of information.

Developmental studies have revealed an asymmetry between direct and indirect sources of information at the conceptual level. For instance, O'Neill and Gopnik (1991) investigated children's ability to identify the sources of their beliefs. In their study, 3- to 5-year-old children discovered what was inside a tunnel in different ways: they looked inside the tunnel, an experimenter told them what was inside the tunnel, they felt what was inside the tunnel, or the experimenter presented them with an object that would allow them to infer what was inside the tunnel (e.g. the experimenter showed them a toy crib and said: "What is inside the tunnel belongs to this"). Then, children were asked a forced-choice source question: "How do you know what is inside the tunnel? Did you see it, did I tell you about it, did you feel it, or did you figure it out from a clue?" Three-year-old children performed worse than 4- and 5-year-olds, even with non-inferential sources. Three- and some 4-year-old children had difficulty with the inferential source as indicated by poorer performance when discriminating inference from a non-inferential source (e.g. seeing) compared to when discriminating between two non-inferential sources (e.g. seeing vs. telling, seeing vs. feeling). The authors concluded that identifying inference as a source of knowledge is particularly difficult for young children. Not only does the ability to identify inferential access as a source of knowledge emerge later than the ability to report visual access or hearsay, but also children's understanding of the causal link between inferential access and knowledge develops later. For

* Ercenur Ünal, University of Delaware, eunal@psych.udel.edu; Anna Papafragou, University of Delaware, papafragou@psych.udel.edu. This research was supported in part by Grant # BCS0749870 from the National Science Foundation to A. P.

example, children attribute inference-based knowledge to another person only after age 6 (Sodian & Wimmer, 1987), even though they know that visual access leads to knowledge and therefore identify perception-based knowledge in another person from early on (Pratt & Bryant, 1990).

How does the ability to think about knowledge sources relate to the ability to verbally encode such sources? Languages indicate how a piece of information is acquired through *evidentiality* markers (Aikenvald, 2004). In English, evidentiality devices are mostly lexical. By contrast, some languages obligatorily express evidentiality through grammaticalized means such as morphology. Turkish grammatically encodes the source of information for all past events with two verbal affixes. The sentences in (1) and (2) provide examples of how speakers of English and Turkish may convey how they accessed the same event:

(1) a. I saw that the boy played.
b. I heard that the boy played.
c. I figured out that the boy played.

(2) a. Çocuk oynadı.
Boy play PAST direct
(I saw that) (a/the) boy played
b. Çocuk oynamış.
Boy play PAST indirect
(I heard/inferred that) (a/the) boy played

In sentence (1a) the speaker conveys that he/she has perceptual access to the event of the boy playing, whereas in (1b) and (1c) the speaker conveys that he/she has indirect access to the event, through the verbal report of another person as in (1b) or inference based on some evidence as in (1c). In sentence (2a) –DI encodes direct evidence and conveys that the speaker has perceptual access to the event, whereas in (2b) –MIS conveys that the speaker has indirect evidence about the event either through hearsay or inference.

Studies with young learners of Turkish and other languages with grammaticalized evidentiality have revealed that full semantic and pragmatic understanding of evidentiality is not completed until the end of kindergarten years, and sometimes even later. In a pioneering study, Aksu-Koç (1988) investigated the acquisition of evidential morphology by Turkish-speaking children. In an elicited production task, 3- to 6-year-old children accessed events acted out with toys from a direct/perceptual or an indirect/inferential perspective and were asked to describe the events. Directly experienced events were expected to be described with –DI and inferred events were expected to be described with –MIS. Children's ability to differentiate the two markers on the basis of their evidential function increased with age. However, even 6-year-olds did not have adult-like performance. Moreover, the trends in the acquisition of two morphemes paralleled the trends in conceptual development, such that the emergence of –DI (i.e. direct past tense) preceded –MIS (i.e. indirect past tense).

These patterns were confirmed across languages by recent experimental studies with young speakers of Turkish (Öztürk & Papafragou, 2008), Tibetan (de Villiers, Garfield, Gernet-Girard, Roeper, & Speas, 2009), Korean (Papafragou, Li, Choi & Han, 2007) and Bulgarian (Fitneva, 2009).

One might hypothesize that the challenge in the acquisition of evidentials originates from a difficulty at the conceptual level. A source of knowledge is an unobservable, abstract concept. Therefore, conceptually representing and differentiating between different sources of knowledge may be a challenge for children, leading to difficulties in semantically and pragmatically mastering evidential categories at the linguistic level. On the other hand, conceptual factors may not be sufficient to explain the challenge in the acquisition of evidentials. Even if children develop an understanding of the different sources that lead to knowledge, they still have to discover the mapping between sources and the corresponding evidentiality devices. Therefore, the origin of the challenge may be at the linguistic level as well.

The present study had three interrelated goals. The first goal was to assess whether Turkish children could acquire knowledge from inferential cues. We focused on probabilistic inference from visual cues. We also manipulated the familiarity of objects as visual cues to assess inferential success. A second goal of our study was to investigate whether the same Turkish-speaking children can linguistically differentiate inference from perception. We tested if children can benefit from inferential cues when they talk about events. Our last goal was to examine the relation between linguistic and non-linguistic representations of source knowledge by comparing the children's performance on the linguistic production and non-linguistic source knowledge tasks.

A prior study by Öztürk and Papafragou (2008) also assessed the relation between the acquisition of linguistic evidentiality and non-linguistic source monitoring with Turkish children (see also Papafragou et al., 2007, on Korean). In this study, 5- to 7-year-old children were presented with events as animated clip art scenes (e.g. a sailboat approached an island) and were asked to (a) describe what happened and (b) say how they know what happened. The findings revealed two asymmetries among sources: (a) children were more successful in correctly producing –DI for directly witnessed events than in producing –MIS for inferred events, and (b) children were more accurate in reporting perception as a source of knowledge than in reporting inference as a source of knowledge. There was also an asymmetry between linguistic and non-linguistic performance, such that children were more accurate in reporting the sources of their knowledge then they were in producing the two makers on the basis of their evidential meaning.

The present study differs from previous studies in several ways. First, we looked at younger children compared to Öztürk and Papafragou (2008). Second, in addition to manipulating the type of evidence for an event, we manipulated the familiarity of objects used as cues for indirect access. Thus, we ended up with a three-way distinction in which direct perception is contrasted with two types of indirect evidence that both involve the use of inferential source.

Moreover, unlike previous studies that rely on explicit methods, we used an implicit measure of source knowledge. Asking children to explicitly report how they found out something can be problematic given that even though some children cannot explicitly report the sources of their beliefs, that have an implicit understanding of the different sources that cause knowledge (Robinson & Whitcombe, 2003). Finally, we used the same materials in the linguistic production and the language-neutral source knowledge experiments. This way, we were able to match the difficulty level of the two tasks and made sure that the differences in performance between the two tasks is not due to a difference in the kind of events that were used.

2. Experiment 1

In Experiment 1 we tested children's ability to link different types of evidence to events. We used a source knowledge task that did not involve the use of evidential language.

2.1 Participants

Participants were native speakers of Turkish in two age groups: 4-year olds (*n*=16, mean age 4;6, range 4;0–4;12) and 5- to 6-year-olds (*n*=16, mean age 6;0, range 5;6–6;10). Children were recruited through preschools in Istanbul, Turkey.

2.2 Materials

The stimuli consisted of photographs giving one of three types of access to events. Examples of different types of access to events are presented in Figure 1. For Direct access, the stimuli were photographs of midpoints of the events including the agents (e.g. a woman drinking milk). There were two types of Indirect access, which differed in terms of the familiarity of objects used as visual cues. For Indirect-Familiar access, the stimuli were photographs of familiar objects in a state that allowed the inferential reconstruction of an event (e.g. someone had knocked down some blocks). For Indirect-Unfamiliar access, the stimuli were photographs of unfamiliar objects in a state that allowed the inferential reconstruction of an event (e.g. someone had knocked down some wood pieces). No agent was present in the Indirect access events.

We used 6 examples of each type of access for a total of 18 events. Two lists of events were created. Direct events were exactly the same across the lists. Since each Indirect event had two versions (Indirect-Familiar and Indirect-Unfamiliar), we never assigned both versions of a single event to a list. For example, for the "knocking down" event, children assigned to the first list were presented with the familiar version of the event (with blocks); children assigned to the second list received the unfamiliar version of the event (with wood

pieces). Each list arranged the events in a single fixed order. Each child was randomly assigned to one of the lists.

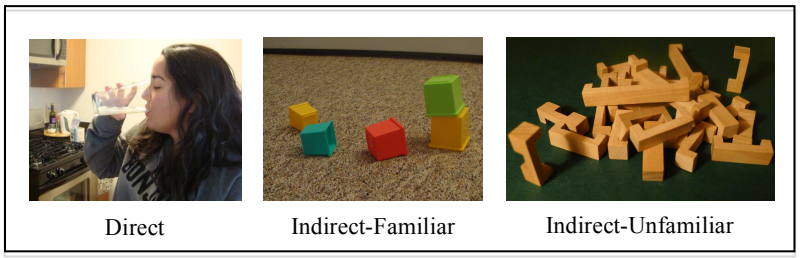

Figure 1. *Examples of Types of Access*

2.3 Procedure

Each child was tested individually in a quiet room at his/her preschool. The experimenter presented children with two cards and said (in Turkish): "*Look, I have two cards here. There is a picture under each card, but we are going to look at only one of these pictures. The other has to be upside down*". Then the experimenter turned one of the cards up and presented children with a photograph that gave one of three types of access to the events (Direct, Indirect-Familiar, or Indirect-Unfamiliar). The experimenter uttered a verb in the infinitive form ("to V") and asked the children to find its picture. Children were reminded that there was another picture under the face down card, and that the picture for the verb could be under that card.

For half of the trials (3 per type of access, 9 in total) the experimenter uttered a verb that matched the visible photograph (e.g. the photograph showed footprints and the children heard "to walk") and for the other half of the trials the experimenter uttered a verb that did not match the visible photograph (e.g. the photograph showed footprints and the children heard "to stack"). We created two lists of verbs, which differed in terms of whether a matching or a mismatching verb was assigned to a given photograph. For example, when presented with the photograph showing footprints, children assigned to the first list heard "to walk", whereas children assigned to the second list heard "to stack". Again, each child was randomly assigned to one of the verb lists. Thus, the assignment of Verb Type to the events was counterbalanced across participants. For each participant, Type of Access in the visible photograph (Direct, Indirect-Familiar, Indirect-Unfamiliar) was crossed with Verb Type (Matching Verb, Mismatching Verb).

2.4 Results

For a given type of access, we were interested in whether children would pick the visible photograph when a matching verb was presented, and avoid the visible photograph and instead pick the face-down card when a mismatching

verb was presented. If so, they would be able to link a directly seen or inferred event with the appropriate event predicate. We tested this with a two-way ANOVA with Type of Access (Direct, Indirect-Familiar, or Indirect-Unfamiliar) and Verb Type (Matching Verb, Mismatching Verb) as within subjects factors. Figure 2 shows the mean percentage of time 4-year-old children picked the visible photograph for each Type of Access and Verb Type. The analysis revealed a main effect of Verb Type ($F(1, 15) = 273.62$, $p < 0.001$), such that children picked the visible photograph for Matching Verbs, and avoided picking the picture and instead picked the face-down option for Mismatching Verbs. There were no effects of Type of Access and no interactions. For each type of access, 4-year-olds performed significantly different from chance performance for both types of verbs.

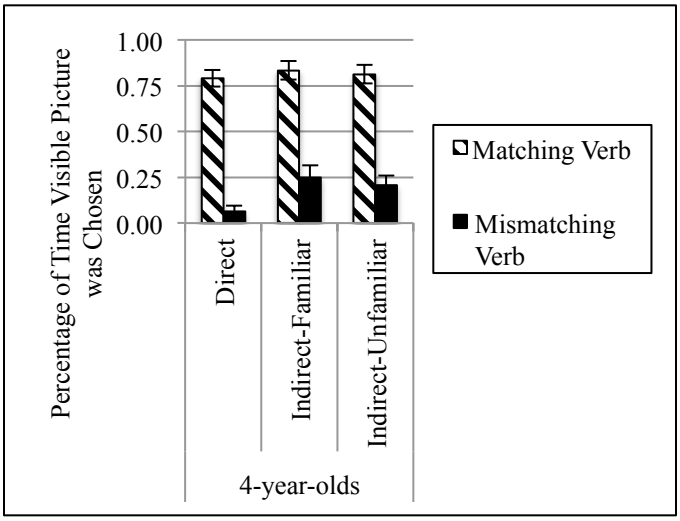

Figure 2. *Choice Of The Visible Picture Across Types Of Evidence And Verb Types (4-Year-Olds)*

The same analysis for 5- to 6-year-olds (see Figure 3) also revealed a main effect of Verb Type ($F(1, 15) = 754.28$, $p < 0.001$). The children successfully linked the matching verbs to visible photographs and avoided linking mismatching verbs to the visible photographs and instead picked the face-down option. Again, there were no effects of Type of Access or interactions. Familiarity of objects used as visual cues did not have an effect. These older children performed significantly different from chance in each type of access for both matching and mismatching verbs. An additional ANOVA adding Age as a factor revealed no effects of Age: overall, 4-year-olds were no less successful than 5- to 6-year-olds.

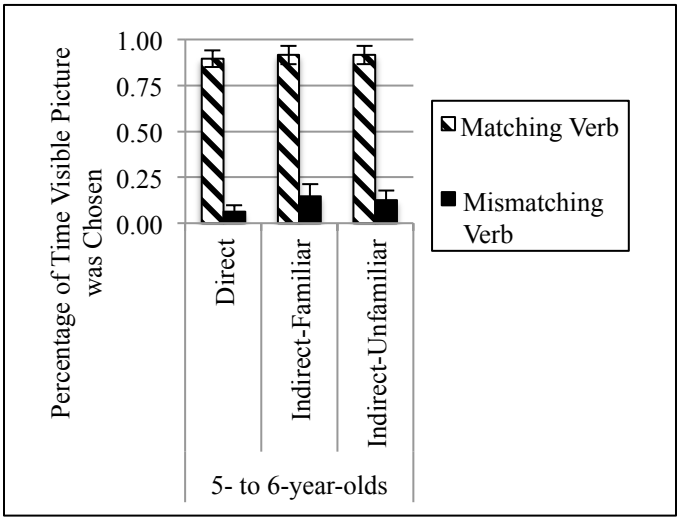

Figure 3. *Choice Of The Visible Picture Across Types Of Evidence And Verb Types (5- to 6-year-olds)*

2.5 Discussion

The findings of Experiment 1 demonstrate that children developed an understanding of direct and indirect sources as indicated by their ability to derive information about events from both perceptual and inferential sources. Even the youngest group of 4-year-old children was able to link the information provided by inferential sources to events. Our findings lower prior estimates for these abilities from previous studies relying on explicit measures (e.g. O'Neill & Gopnik, 1991; Öztürk & Papafragou, 2008).

3. Experiment 2

In Experiment 2 we investigated children's ability to produce evidential morphology using an elicited production task.

3.1 Participants

Participants were the same children as in Experiment 1. For each child, the production task was administered after the source knowledge task.

3.2 Materials

The stimuli consisted of photographs giving three types of access for events. The three types of access were the same as the ones in Experiment 1

(Direct, Indirect-Familiar, Indirect-Unfamiliar); however, the photographs depicted evidence for a new set of 9 events. There were 3 events per type of access. The photographs were presented in a randomized order. The same type of counterbalancing as in Experiment 1 was followed.

3.3 Procedure

Children were presented with one photograph at a time. They were told that these were photographs of past events and were asked to describe what happened in the photographs to Mr. Owl, a puppet. In order to elicit the use of past tense, children were instructed to start their descriptions with the word "yesterday". Children's descriptions were recorded by the experimenter.

3.4 Results

Children's descriptions were transcribed and coded for the use of evidential morphology. Figure 4 presents a breakdown of children's descriptions for the use of past tense (i.e. evidential) and non-past tense markers. We can see that children occasionally ignored the instruction to treat these as past tense events and used other morphological devices (e.g. present tense) to talk about them. Children's descriptions were assessed with a mixed ANOVA with Type of Access (Direct, Indirect-Familiar, Indirect-Unfamiliar) and Tense (Past, Non-Past) as within subjects factors and Age (Four, Five to Six) as a between subjects factor. The analysis revealed only a main effect of Tense ($F(1, 30) = 19.14$, $p < 0.001$). Overall, children used more past tense descriptions than non-past tense descriptions. There were no effects of Type of Access or Age or any interactions.

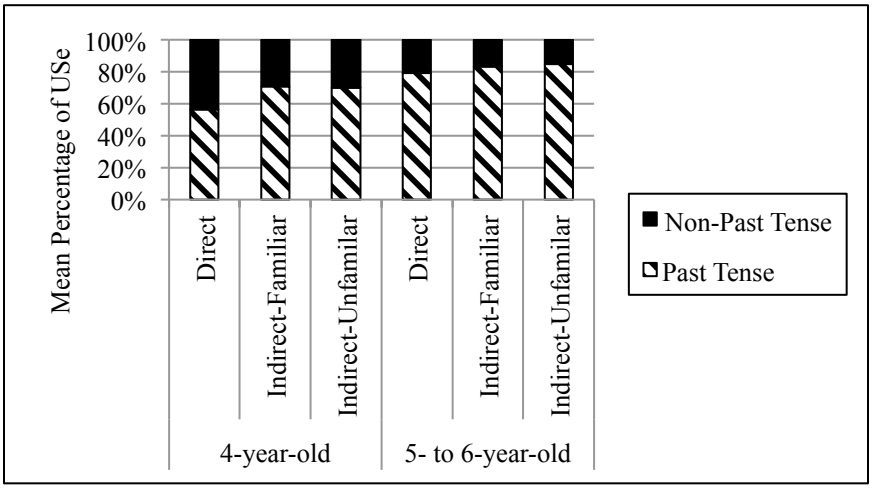

Figure 4. *Breakdown Of Children's Descriptions Across Types Of Evidence*

Next, we assessed children's use of the two past tense markers for each type of access. Of interest was whether direct access to events would lead to the production of –DI and both types of indirect access to events would lead to the production of –MIS. We tested these possibilities with a mixed ANOVA with Type of Access (Direct, Indirect-Familiar, Indirect-Unfamiliar) and Morpheme (Direct Past Tense/-DI, Indirect Past Tense/-MIS) as the within subject factors and Age (Four, Five to Six) as the between subject factor. All non-past tense descriptions were excluded from the analysis. The analysis revealed a near significant interaction between Morpheme and Type of Access, $F(2, 46) = 2.96$, $p = 0.06$. For Direct Access, children were equally likely to use direct and indirect past tense, whereas for both types of Indirect-Familiar ($t(24) = -2.62$, $p = 0.015$) and Indirect-Unfamiliar Access ($t(24) = -2.03$, $p = 0.05$), children were more likely to correctly produce the indirect past tense than the direct past tense. A further ANOVA adding Age as a factor revealed no Age effects or interactions with Age: 5- to 6-year-olds were no more successful than 4-year-olds in using the two past tense markers based on their evidential function.

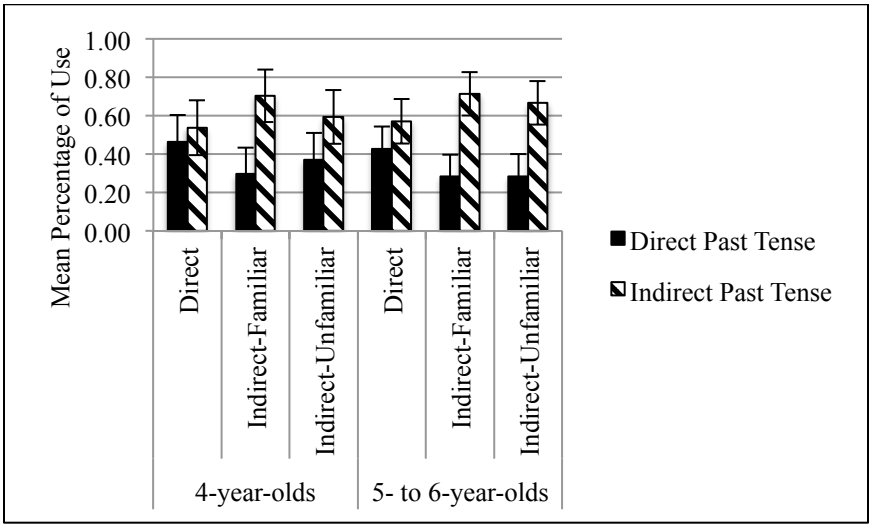

Figure 5. *Children's use of Direct and Indirect Morphemes in Past Tense Descriptions Across Types of Evidence*

3.5 Discussion

The findings of Experiment 2 suggest that children have not fully mastered the evidential categories in the morphology of their language. Even the oldest group of children had difficulty modifying their descriptions based on the evidence they were presented with. Thus, the children in our sample are still in the process of acquiring linguistic evidentiality.

It may be surprising that the children do not reserve –DI for direct events given that direct past tense was found in other studies to emerge earlier than indirect past tense (Aksu-Koç, 1988; Öztürk & Papafragou, 2008). We speculate that children may not perceive the events in our stimuli as direct enough linguistically, even though non-linguistically they can derive information from direct/perceptual events. Since we used snapshots of events, these may not count as equivalent to first-hand experience, therefore children decide to mark these with the indirect past tense.

4. Conclusions

In this study we assessed 4- to 6-year-old Turkish-speaking children's ability to produce evidential morphology for events they accessed directly or indirectly. We also assessed the same children's ability to derive information from direct and indirect sources. We observed that children who have not fully mastered evidential categories in their language have nevertheless developed an understanding of perceptual access and inference from visual cues as sources of knowledge. Thus, we conclude that the conceptual representations of sources of knowledge emerge earlier than linguistic evidentiality.

Our findings confirm the conclusion of prior research that linguistic evidentiality poses a challenge for young learners of Turkish. The findings of the experiments reported in this study suggest that this challenge, at least partly, originates from linguistic factors. Since sources of knowledge are abstract concepts, there are no observable referents for evidentiality markers. Therefore, children have to recognize the correspondence between these linguistic devices and different sources of information. Sources of knowledge differ from each other in very subtle ways. It may take multiple exposures for children to observe the fine-grained differences among the conditions under which each of the evidentiality markers are uttered and thereby successfully acquire the evidential system of their language.

References

Aikhenvald, Alexandra Y. (2004). *Evidentiality*, Oxford University Press, Oxford.

Aksu-Koç, Ayhan. (1988). *The Acquisition of Aspect and Modality: The case of past reference in Turkish.* Cambridge: Cambridge University Press.

Fitneva, Stanka A. (2009). Evidentiality and trust: The effect of informational goals. In Stanka A. Fitneva & Tomoko Matsui (Eds.), *Evidentiality: A window into language and cognitive development, New Directions for Child and Adolescent Development, 125*, 49–61. San Francisco: Jossey-Bass.

Johnson, Marcia K., Hashtroudi, Shanin, & Lindsay, D. Stephen. (1993). Source monitoring. *Psychological Bulletin,114*, 3–28.

O'Neill, Daniela K., & Gopnik, Alison. (1991). Young children's ability to identify the sources of their beliefs. *Developmental Psychology*, 27, 390-397.

Öztürk, Özge, & Papafragou, Anna. (2008). The acquisition of evidentiality and source monitoring. *Proceedings of 32nd Annual Boston University Conference on Language Development,* 368-377. Somerville, MA: Cascadilla Press.

Papafragou, Anna, Li, Peggy, Choi, Youngon, & Han, Chung-hye. (2007). Evidentiality in language and cognition. *Cognition, 103*, 253–299.

Pratt, Chris & Bryant Peter. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child Development*, 61, 973-982.

Robinson, Elizabeth J., & Whitcombe, E. L. (2003). Children's suggestibility in relation to their understanding about sources of knowledge. *Child Development*, 74, 48-62.

Sodian, Beate, & Wimmer, Heinz. (1987). Children's understanding of inference as a source of knowledge. *Child Development, 58*, 424-433.

de Villiers, Jill, Garfield, Jay, Gernet-Girard, Harper, Roeper, Tom, & Speas, Margaret. (2009). Evidentials in Tibetan: Acquisition, semantics, and cognitive development. In S. A. Fitneva & T. Matsui (Eds.), *Evidentiality: A window into language and cognitive development, New Directions for Child and Adolescent Development, 125*, 29–47. San Francisco: Jossey-Bass.