Linguistic Encoding of Inferential Evidence for Events

Gökçen Avcılar (gokcen.avcilar@ozu.edu.tr)
Ozyegin University, Istanbul, Turkey

Ercenur Ünal (ercenur.unal@ozyegin.edu.tr)
Ozyegin University, Istanbul, Turkey

Abstract

How people learn about events often varies with some events perceived in their entirety and others are inferred based on the available evidence. Here, we investigate how children and adults linguistically encode the sources of their event knowledge. We focus on Turkish – a language that obligatorily encodes source of information for past events using two evidentiality markers. Children (4- to 5-year-olds and 6- to 7-year-olds) and adults watched and described events that they directly saw or inferred based on visual cues with manipulated degrees of indirectness. Overall, participants modified the evidential marking in their descriptions depending on (a) whether they saw or inferred the event and (b) the indirectness of the visual cues giving rise to an inference. There were no differences across age groups. These findings suggest that Turkish-speaking adults' and children's use of evidential markers are sensitive to the indirectness of the inferential evidence for events.

Keywords: evidentiality; events; visual perception; visual inference; Turkish

Introduction

Gaining knowledge about people, objects, situations and events is a fundamental aspect of an individuals' life. Knowledge about events is particularly important as events provide a rich source of information that allow individuals to predict upcoming happenings and remember past experiences (Zacks & Tversky, 2001). However, how individuals gain knowledge about events often varies depending on the perspective of the observer (Gleitman, 1990). For instance, one might directly observe someone slicing a cucumber or only see a sliced cucumber on a plate and make the inference that someone sliced a cucumber. In addition to gaining information about events, people also frequently communicate about those events that they have learned about. The aim of the current study is to investigate how children (and adults) communicate about the sources of their event knowledge with a particular emphasis on different types of indirect inferential evidence.

How children gain knowledge about events from various sources of information can be viewed as part of a growing literature on children's event perception (e.g., Baldwin & Kosie, 2021; Zheng, Zacks, & Markson, 2020) as well as a separate line of work on the acquisition of verbs referring to different types of events (e.g., Gleitman, 1990; Pinker, 1989; Tomasello & Merriman, 2014) or different types perceptual experience (e.g., Davis & Landau, 2021). However, with the exception of a few studies, this body of work focused on events that can be directly observed in their entirety. One recent study investigated preschoolers' ability to identify events by directly seeing them or by indirectly learning about them from visual evidence (Ünal & Papafragou, 2019). Findings have shown that although there were some developmental differences between older and younger children, even the youngest group of 4-year-olds were able to derive rich interpretations about events based on both direct and indirect visual evidence.

How does the ability to learn about events from different sources of information relate to the ability to linguistically encode such sources? Languages convey how a speaker has learned about an event through *evidentiality* markers (Aikhenvald, 2004; Aikhenvald, 2018). Languages also differ in the kinds of linguistic devices they rely on to encode evidentiality. Some languages (e.g., English) optionally encode evidentiality through lexical devices such as verbs (e.g., see, hear, infer) or adverbs (e.g., allegedly, apparently). By contrast, some languages obligatorily encode evidentiality as part of their grammar. In the following example from Turkish, which will be the focus of the current study, two different suffixes (-dı and -mış) mark sources of information for past tense events (Aksu-Koç & Slobin, 1986). Sentence (1a) refers to the speaker's past experience of the event and also conveys that the speaker's source of information for the event is direct with the suffix -dı. Sentence (1b) describes the same past event but also conveys the indirect experience of the speaker, which could be either hearsay or inference, with the suffix -mış.

(1a) Salatalığ-ı doğra-dı.
cucumber-ACC slice-PAST.Direct.3sg
"(she/he) sliced the cucumber (I saw)"

(1b) Salatalığ-ı doğra-mış.
cucumber-ACC slice-PAST.Indirect.3sg
"(she/he) sliced the cucumber (I heard/inferred)"

How children learn the evidential systems of their language has been investigated across several languages (see Fitneva, 2018 and Matsui, 2014 for recent reviews). Across languages and, perhaps more importantly for our study, in Turkish the acquisition of evidentiality follows a protracted developmental trajectory (Aksu-Koç, 1988; Aksu-Koç, Ögel-Balaban, & Alp, 2009; Ozturk & Papafragou, 2016). With the exception of one study (Ünal & Papafragou, 2016), this work has shown that Turkish-speaking children begin using the direct evidential marker (-dı) to mark the direct access to information earlier than they use the indirect evidential

marker (-mış). However, a longitudinal corpus study with 8- to 36-month-olds investigating the acquisition of different functions of the indirect evidential marker (-mış) revealed more optimistic results on children's production of indirect evidential marker (Uzundag et al., 2018). That is, children could use the indirect evidential (-mış) before age 3, even though they used it to mark hearsay earlier than they used it to mark inference.

As already mentioned, in Turkish the indirect evidential marker (-mış) is used for marking different types of indirect evidence which include both hearsay and inference. Furthermore, there might be even more fine-grained distinctions between types of inference, such as inferences based on visual evidence or inferences for communication. In fact, two pieces of evidence suggest that inferences from visual evidence is not a homogeneous category and the variation in types of inferential evidence is linked to evidential encoding in language. One cross-linguistic study examined how speakers of English (a language that encodes the information sources optionally) and Turkish (a language that encodes information sources obligatorily) describe the events they saw vs. inferred based on visual evidence (Ünal, Pinto, Bunger, & Papafragou, 2016). In this study, both Turkish and English speakers successfully identified both seen and inferred events from visual evidence; however, only Turkish adults used evidential markers in their descriptions to linguistically mark sources of information. Specifically, Turkish-speaking adults marked the events they saw with the direct evidential (-dı) and events they inferred from visual evidence with the indirect evidential (-mış). However, their use of indirect evidential varied depending on the strength of the visual evidence that gave rise to an inference: they opted to reserve the indirect evidential marker (-mış) for inferences based on highly indirect visual cues; however, when the visual cues giving rise to an inference was less indirect they were equally likely to use the direct evidential marker (-dı) and the indirect evidential (-mış).

Another piece of evidence comes from artificial language learning studies in the domain of evidentiality (Saratsli et al., 2020; Saratsli & Papafragou, 2020). In one of these studies, English-speaking adults were taught an evidential marker: -ga. For half of the participants -ga marked visual perception, for the other half -ga marked inference based on visual cues. In each condition, the other event type was unmarked. Participants had difficulty learning the evidential system when visual perception was contrasted to inferences made by observing the end-state of an event that also included the agent. However, when the visual cues did not include the agent, and hence were more indirect, participants successfully learned the evidential system. These findings suggest that part of the challenge in the acquisition of evidentiality in language can be attributed to the difficulties in distinguishing visual perception from visual inference. This challenge seems to be bigger when the visual cues giving rise to inferences are less indirect.

The Present Study

Findings of prior work with adults indicate that fine-grained distinctions within types of indirect inferential evidence have consequences for both how mature speakers use evidential markings (Ünal et al., 2016) and the learnability of evidential systems by novice learners (Saratsli & Papafragou, 2020). It remains an open question whether these distinctions within types of indirect inferential evidence also have consequences for the acquisition of grammaticalized evidentiality. To address this question, we investigate how children (and adults) linguistically encode the sources of their event knowledge with a production task. We use puppet theater setup inspired by some of the early (Aksu-Koç, 1988) and more recent (Ünal & Papafragou, 2016) work in this domain since this setup has been quite successful in eliciting evidential markers from children in experimental settings. Of interest was whether children would mark their sources of event knowledge differently depending on the type of evidence, and particularly distinguish between different levels of indirect evidence for events. We also ask whether there were developmental differences between adults and children.

Method

The stimuli are available at the Open Science Framework Repository https://osf.io/ra7eb/. The methods and analyses plans are preregistered at the Open Science Framework https://osf.io/ra9ch.

Participants

We recruited a preregistered a sample of 108 native speakers of Turkish distributed across three age groups: adults (n = 36, 31 Female, Mean Age = 21), 4- and 5-year-olds (n = 35, 17 Female, Mean Age = 4.9) and 6- and 7-year-olds (n =37, 19 Female, Mean Age = 6.6). Data from one additional 4- to 5-year-old was excluded due to interference from the parent during data collection.

Sample size was determined based on an a priori power analysis using a web application for power analysis with mixed effects models that include one fixed factor with two levels (Westfall, Kenny, & Judd, 2014; https://jakewestfall.shinyapps.io/crossedpower/). Previous work reported an effect size of d = 2.11 (Ünal & Papafragou, 2016). We estimated a more conservative effect size of d =1.05 for the present study. The number of trials was set to 8 as we would have 8 data points if we were to directly compare two conditions (see Materials below). We used the default settings for random effects provided by the application. The analysis revealed that in order to reach a power level of 0.90 we would need a minimum of 18.4 participants in each group. Since our independent variable had 3 levels instead of 2 and to be able to detect smaller effect sizes, we doubled the number of participants for each age group and decided to recruit 36 participants for each age group.

Materials

There were two types of stimuli: target items and filler items. Target items consisted of 12 different change of state events which were performed by an actor (e.g., slicing cucumber). The same male actor performed all events in front of a plain wall and a table that did not contain any distractive items. Each event had visibly distinct beginnings, midpoints and endpoints. We created a puppet theatre scenario using the video editing program iMovie. We added curtain effects at different parts of the event (e.g., beginning, midpoint) to manipulate type of evidence for the event (henceforth Event Type). There were three Event Types. For Direct events, curtains opened at the beginning remained open while the actor was performing the event so that the entire event was directly visible to the participants (Figure 1, top row). For Indirect-Low events, only the beginning and endpoint of the event was visible to the participants. At the beginning of the event, participants saw the actor and an object with curtains open for 3 seconds (Figure 1, middle row, first picture). Then the curtains closed for 2 seconds (Figure 1, middle row, second picture). When the curtains opened again, participants saw the endpoint of the event depicted by the post-change state of the object together with the actor (Figure 1, middle row, last picture). Indirect-High events were exactly same as the Indirect-Low events, except that when the curtains re-opened at the end, the actor was not present (Figure 1, bottom row). This manipulation was based on previous work showing that seeing an agent vs. not at the endpoint has implications for learnability of evidential systems; Saratsli & Papafragou, 2020.

Figure 1. Snapshots of sample stimuli for Direct, Indirect-Low and Indirect-High Events.

Filler items consisted of 12 different videos of objects (e.g., pencils, cars) placed on a table in front of a plain wall. They were fully visible throughout the trial. The actor was not present in the videos. Participants were asked to identify the objects and answer a question about a property of the object (e.g., color, number, function). Filler trials were included to avoid priming of evidential markers from one trial to the next one.

Three presentation lists were created by assigning one version of each target event (Direct, Indirect-Low, Indirect-High) to one of the lists. Thus, the event type for a given event (Direct, Indirect-Low, Indirect-High) was counterbalanced across lists. Event type was manipulated within-subjects with each list including 12 target items in total, consisting of 4 examples of each Event Type.

There were also 6 filler items[1] in each list. Initially we had planned to include an equal number of target and filler items (12 each). However, pilot work showed that the experiment was too long for the youngest group of participants. Thus, we included only 6 filler items. Each list arranged the items in a single fixed order. One filler item was shown after every two target items. Each participant was randomly assigned to one of the three lists.

Procedure

Children and adults completed the study via Zoom by interacting with a live experimenter who navigated a PowerPoint slideshow. After a warm-up session, the experiment started. The experimenter said (in Turkish): "You will watch some videos now. After watching each video, I want you to tell me what happened in the video." If the child was too shy, the experimenter encouraged the child to describe the event by beginning a sentence and letting them finish it: "salatalığı…" lit. "(the) cucumber…". Since Turkish is a verb-final and head-final language, the evidential markers are attached to the end of the verb, which also appears last in the sentence. Thus, the fact that the experimenter started the sentence was unlikely to affect the production of evidential markers. Furthermore, since in Turkish the verb is marked for person and number, the noun phrases or pronouns referring to the agent can be omitted. Thus, naming only the object that went under a change is a natural way to begin a sentence describing a change of state event in Turkish. Participants' descriptions were videotaped for coding. There were no differences during the implementation of the experiment for adult participants except that child participants were accompanied by their parents, whereas adult participants were alone. The entire session lasted about 20 minutes.

Coding

Descriptions were transcribed and coded by a native speaker of Turkish. We coded whether participants marked their event descriptions with direct evidential marker (coded as -dı), indirect evidential marker (coded as -mış) or something different than -dı and -mış (coded as "other").

Results

Data and analysis scripts are available at the Open Science Framework Repository https://osf.io/ra7eb.

[1] Due to an experimenter error the filler items shown in each presentation list were not the same six events.

We excluded the trials in which participants did not use evidential markers to describe the events (i.e., "other" category above) from the analyses (11.9% of the data). We also excluded the trials in which the parents interfered with the children's responses or when there was an experimenter error (2.3% of the target trials).

For our main analysis, we conducted a binomial linear mixed effects model with crossed random intercepts for Subjects only (Baayen, 2008; Baayen, Davidson, & Bates, 2008) using the *glmer* function of the *lme4* package (Bates et al. 2015) in *R* (R Core Team 2020). A more complex model that also included random intercepts for Items produced singular fit error indicating that that the model was over-fitted and too complex for the data. Thus, random intercepts for Items were excluded from the model. Our dependent variable was binary values of the use of the evidential marker -dı (1 = -dı is used, 0 = -dı is not used) at the item level. Since the analysis was conducted on only the trials in which an evidential marker was used, when participants did not use direct evidential (-dı) they used indirect evidential (-mış). The fixed effect of Age was tested with two planned contrasts. The first contrast compared children to adults (4- to 5-year-olds contrast coded as 1/3, 6- to 7-year-olds contrast coded as 1/3, adults contrast coded as -2/3). The second contrast compared younger vs. older children (4- to 5-year-olds contrast coded as 1/2, 6- to 7-year-olds contrast coded as -1/2, adults contrast coded as 0). The fixed effect of Event Type was also tested with two planned contrasts. The first contrast compared direct events to indirect events (Direct contrast coded as -2/3, Indirect-Low contrast coded as 1/3, Indirect-High contrast coded as 1/3). The second contrast compared the two types of Indirect events to each other (Direct contrast coded a 0, Indirect-Low contrast coded as 1/2, Indirect-High contrast coded as -1/2).

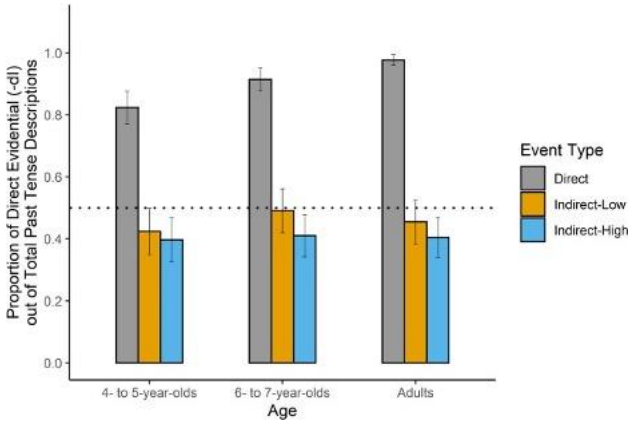

Figure 2: Proportion of direct evidential maker (-dı) out of all evidentiality marker uses. Error bars indicate standard error. Scores above the dotted line and closer to 1 indicate that participants were more likely to use direct evidential (-dı); and scores below the dotted line and closer to zero indicate that participants were more likely to use indirect evidential (-mış).

The model revealed a significant intercept (β = 1.132, SE = 0.316, z = 3.583, p < .001) indicating that overall participants were more likely to produce direct evidential marker (-dı) than the indirect evidential marker (-mış). Furthermore, both of the contrasts of Event Type were significant indicating that participants modified the evidential marking in the description according to type of evidence. More specifically, participants were more likely to produce direct evidential (-dı) for direct events than indirect events (β = -5.069, SE = 0.453, z = -11.182, p < .001). Furthermore, participants were more likely to produce direct evidential marker (-dı), and thus less likely to produce indirect evidential (-mış), for Indirect-Low events than Indirect-High events (β = 0.469, SE = 0.221, z = 2.119, p = .034). No other effects or interactions were statistically significant, indicating that these patterns were similar across children and adults.

Discussion

In this study, we investigated how children (and adults) linguistically encode the sources of their event knowledge with an emphasis on inferential evidence with different degrees of indirectness. We had two main aims. First, we asked whether participants would mark different event types with different evidential marker, and especially distinguish between different types of indirect inferential evidence. Second, we asked whether there were any developmental differences in the adult-like uses of evidential markers.

With regards to our first question, as expected, there were differences between direct events and both types of indirect events in terms of production of evidential markers. Participants overwhelmingly produced direct evidential marker (-dı) for direct events and this tendency was lessened for both types of indirect events, as participants frequently produced indirect evidential marker (-mış) for these events. This finding is consistent with previous research showing that Turkish-speaking children and adults mark the events they see with direct evidential marker (-dı) and events they infer with indirect evidential marker (-mış) (Aksu-Koç, 1988; Ozturk & Papafragou, 2016; Ünal & Papafragou, 2016; Ünal et al., 2016).

We also found some subtle differences between the two types of indirect events in terms of the linguistic marking of the presence of an inference. That is, participants were more likely to use direct evidential marker (-dı) for Indirect-Low events which yielded more secure inferences about what happened compared to Indirect-High events that provided weaker visual evidence and hence yielded less secure inferences. This replicates previous findings with Turkish-speaking adults (Ünal et al., 2016). As a novel finding, we show that Turkish-speaking children's use of indirect evidential marker (-mış) is also sensitive to the indirectness of inferential evidence for events. These findings also cohere with recent evidence from artificial language learning studies on the learnability of evidential systems (Saratsli & Papafragou, 2020; Saratsli et al., 2020). In those studies, novice learners had less difficulty learning an evidential system distinguishing visual perception from visual inference

based more indirect cues. Similarly, in our study Turkish-speaking children (and adults) had less difficulty modifying the evidential marking in their descriptions when they inferred what happened based on more indirect cues.

Our second main aim was to see whether there were any developmental differences in the use of evidential markers across different types of evidence for events. We found no developmental differences, indicating that even the youngest group of 4- to 5-year-olds were adult-like in their use of evidentiality markers. These findings are consistent with recent experimental evidence on the acquisition of evidentiality (Ünal & Papafragou, 2016) as well as evidence from corpus studies focusing on the acquisition of different functions of the indirect evidential marker (-mış) in Turkish (Uzundag et al., 2018). On the other hand, these data seem to contrast with other work showing that the production of indirect evidential, especially to mark an inference, is a late achievement (Aksu-Koç, 1988, Aksu-Koç et al., 2009; Ozturk & Papafragou, 2016). Besides, the present study revealed a novel finding that Turkish-speaking children also demonstrated a sensitivity to the different indirectness level of an event and demonstrated this sensitivity by producing different evidential marker. We believe this difference can be explained by the contrastive nature of the puppet theater setup which provides visible cues (i.e., curtains opening and closing) as a way to distinguish between different sources of information. These cues might have facilitated children's ability to modify the evidential marking in their descriptions. Future work can utilize this setup and introduce the curtain effect at different phases of the event (e.g., before the agent acts on the object) to better understand how sensitive children are to the amount of information they miss and thus the kind of inference they need to make. Since even the youngest group's (4- to 5-year-olds) production was adult-like, future work could see if similar patterns emerge in younger age groups such as 2- or 3-year-olds. Future work could also test if children are also sensitive to the indirectness of the inferential evidence in language comprehension. Since several studies on the acquisition of evidentiality have shown that children's evidential comprehension lags behind their production (Aksu-Koç, 1988; Ünal & Papafragou, 2016, a.o.), this approach may be useful to fully sketch the developmental timetable of the acquisition of evidentiality.

There is one aspect of our findings that needs to be considered in more detail. Although the fact that both children's and adults' use of evidential markers was sensitive to the types of inferential evidence, neither children nor adults produced the indirect evidential marker (-mış) overwhelmingly for highly indirect events. On average, they used the indirect evidential marker (-mış) about 60% of the time. This contrasts with previous findings with Turkish-speaking adults (Ünal et al., 2016) and children (Ünal & Papafragou, 2016). In those studies, participants produced the indirect evidential marker for events equivalent to our Indirect-High events for about 80% of the time. This difference can be attributed to the following factors.

First, unlike previous work requiring children to contrast two different types of events (e.g., seen vs. inferred; Ozturk & Papafragou, 2016; Ünal & Papafragou, 2016), in the current paradigm, children had to contrast three different types of events (i.e., Direct vs. Indirect-Low vs. Indirect-High). The requirement to make a three-way distinction might have made the production task more challenging for children and skewed the description data towards higher use of direct evidential marker. This can be attributed to the fact that the direct evidential marker -dı in Turkish may also considered to be a default form of past tense that could be somewhat neutral with respect to information source, whereas –mış marks indirect information (Göksel & Kerslake, 2005). Therefore, when the task becomes more demanding, participants may be more likely to use a default form of past tense. However, this aspect of the task was similar to previous paradigms used with adults (Ünal et al., 2016) and thus would not likely explain why adults did not overwhelmingly use indirect evidential for the highly indirect events.

Second, the individual events used in the present study were not identical to the events used in prior studies. The highly indirect versions of some of our events may not be as indirect as those used in previous work. Although all of our events were examples of change-of-state events, each event has a different internal structure. For example, some events (e.g., building blocks) may consist of more distinct sub-stages. Other events (e.g., inflating a balloon) might have sub-stages that are more continuous or similar to each other. Thus, the visual cues depicting the end-states of different events may also vary in terms of their indirectness. In other words, if participants judged some of our Indirect-High events as less indirect, they might had used indirect evidential (-mış) less frequently. Future work is needed to better understand the contribution of these factors to how children reconstruct events from different types of visual cues, as well as how they linguistically convey what they have reconstructed.

Finally, it is also possible that even though children and adults made inferences from highly indirect visual cues, they might have conveyed the presence of an inference using different means, such as lexical devices. Alternatively, they might have chosen not to communicate about their inferences at all. This last point also connects to a broader discussion about the role of pragmatic factors in the use of evidentiality devices in language. Recent work started examining the role of these factors learnability of evidential systems (Saratsli & Papafragou, 2021). However, more work is needed to understand the precise contribution of these pragmatic factors to the acquisition and use of evidential systems in language.

Even though the present study only focused on the linguistic encoding of evidence for events, our findings may have broader implications for how people draw the boundary between visual perception and visual inference or between different types of visual inference in cognition. Our findings suggest that these boundaries may not always be very clear. Instead, what makes a particular piece of visual evidence less or more indirect seems to be collectively characterized by

several features, potentially including knowledge about who performed an event as well as other factors, such as event structure.

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