Pragmatic Effects on the Learnability of Evidential Systems

Dionysia Saratsli and Anna Papafragou

1. Cross-linguistic prevalence of semantic distinctions

Certain linguistic distinctions appear to be prevalent across different languages. An assumption often found in the literature is that cross-linguistically more frequent distinctions are easier to learn than less frequent ones by virtue of being conceptually more natural (Rosch, 1972; Clark, 1976; Pinker, 1984; Slobin, 1985; Bowerman, 1993). Gentner and Bowerman (2009) effectively captured this idea in their Typological Prevalence Hypothesis: "All else being equal, within a given domain, the more frequently a given way of categorizing is found in the languages of the world, the more natural it is for human cognizers, hence the easier it will be for children to learn" (p. 467). Gentner and Bowerman used this hypothesis to explain the relative ease of acquiring spatial support vocabulary across English and Dutch learners. However, empirical tests of this hypothesis with other semantic distinctions are lacking.

A growing research strand that could potentially offer valuable evidence on the factors that motivate recurring distinctions across languages is Artificial Language Learning. Studies that utilize an Artificial Language Learning paradigm typically require participants to learn different versions of a target miniature language that differ minimally from each other in terms of a grammatical or lexical feature (Folia, Uddén, de Vries, Forkstam, & Petersson, 2010). During an initial learning phase, participants are exposed to the grammar/lexicon of the artificial language. This phase is followed by a test phase assessing how well participants learned the distinction they were exposed to. This experimental paradigm offers a unique opportunity to explore participants' learning process in relation to a specific linguistic feature of interest (Fedzechkina, Newport & Jaeger, 2016) bypassing the role of frequency or complexity of actual systems across different languages. To date, Artificial Language Learning studies have confirmed the hypothesis that cross-linguistically frequent patterns are easier to learn than less common ones in the domain of syntax (Christiansen, 2000; Hudson Kam & Newport, 2009; Tily, Frank, & Jaeger, 2011; Culbertson, 2012; Culbertson & Smolensky, 2012), phonology (Seidl & Buckley, 2005; Wilson, 2006; Finley & Badecker, 2009) and morphology (Merkx, Rastle, & Davis, 2011; Fedzechkina, Jaeger, & Newport, 2012). However, there is no extensive empirical work

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specifically exploring the learnability patterns for semantic distinctions. Our study will begin to fill this gap focusing on the semantic domain of evidentiality.

2. Evidentiality across languages

Evidentiality refers to the way that language marks the speaker's source of information, for instance, whether the speaker had direct perceptual access to an event, inferred what happened based on clues, or was told what happened by someone else. Languages differ in the way they encode evidentiality (Chafe & Nichols, 1986; Willet, 1988; Ifantidou, 2001; Delancey, 2002; McCready, 2008; Aikhenvald, 2014, 2018). A quarter of the world's languages use grammatical morphemes to indicate information sources while English and other languages make use of lexical means such as verbs (e.g., *see, hear, infer*) or adverbs (e.g., *allegedly*) (Speas, 2004; Faller, 2014). Across languages with grammaticalized evidentiality, the complexity of their evidential systems varies. Below we give an example from Wanka Quechua that has separate grammatical morphemes for three types of information source (Aikhenvald, 2004): *-mi* in (1) marks the speaker's visual experience, *-chr-* in (2) marks an inference drawn by the speaker, and *–shi* in (3) marks another person's report about what happened.

1. Chay-chruu-*mi* achka wamla-pis walashr-pis alma-ku-lkaa-ña.
   this-LOC-*DIR.EV* many girl-TOO boy-TOO bathe-REEL-IMPF.PL-NARR.PAST.
   'Many girls and boys were swimming' (I saw them).

2. Daañu pawa-shra-si ka-ya-n-*chr*-ari.
   Field finish-PART-EVEN be-IMPF-3-*INFR*-EMPH.
   'It (the field) might be completely destroyed' (I infer).

3. Ancha-p-*shi* wa'a-chi-nki wamla-a-ta.
   too.much-GEN-*REP* cry-CAUS-2 girl-1P-ACC.
   'You make my daughter cry too much' (they tell me).

Semantically, the broad meaning dimensions that characterize grammatical evidentiality across languages involve visual perception, inference (either from visual premises or from other types of cues) and verbal report (i.e., hearsay or quotative information) (Willett, 1988; Aikhenvald, 2014, 2018; de Haan, 2013). Languages that only have one evidential morpheme most often encode reports while other types of information sources remain unmarked (Aikhenvald 2004, 2018). However, evidential systems that mark only direct (visual) access but do not grammatically encode other source types are unattested.

Pragmatically, the use of evidentially marked utterances can give rise to contextual implications about speaker certainty or reliability. In this sense, linguistic evidentiality connects to the human ability to reason about sources of information (see Papafragou, Li, Choi & Han, 2007; Ünal & Papafragou, 2018).

Visual experience of an event is considered to be a more reliable source because it generally reflects first-hand access; inference or reports are often viewed as less reliable since they can be based on incomplete premises or unreliable cues (Papafragou et al., 2007; Matsui & Fitneva, 2009; Koring & De Mulder, 2015; Aikhenvald, 2018; Wiemer, 2018).

Because the cross-linguistic frequency of encoding of different information sources differs, evidentiality constitutes an ideal test bed for exploring whether cross-linguistic frequency affects the learnability of semantic distinctions (as well as the underlying reasons for these patterns). In Saratsli et. al. (2020), we addressed this question: we conducted a series of Artificial Language Learning experiments in which participants were exposed to stimuli where a speaker got informed about different events through visual experience, inference or third-person reports but marked only one information source by a morpheme. Depending on which source was marked, we created three distinct evidentiality systems: Visual, Inference and Reportative. Each participant was only exposed to one of those Systems and was later tested on their understanding and use of the novel morpheme. Interestingly, the learning rates were in line with the cross-linguistic frequency patterns: the evidential system that marked reportative information was consistently easier for participants to learn but the system that only marked visual information was the hardest to learn (the system marking only speaker's inference gave mixed results but patterned more closely to the visual system). These results align with the hypothesis that the most frequent semantic distinctions are the easiest to learn. However, they leave open the possible reasons for the observed learnability (and frequency) patterns.

At first glance, the Typological Prevalence Hypothesis (Gentner & Bowerman, 2009) successfully predicts the Saratsli et al. (2020) results. Notice, though, that visual perception cannot be considered an "unnatural" concept. Early in development, children understand that visual access to an event comprises a source of knowledge (Pillow, 1989; Ozturk & Papafragou, 2016). Additionally, a variety of verbs across different languages encode distinctions in the domain of vision and these information-access meanings seem to be accessible even in congenitally blind individuals (Landau & Gleitman, 1985). Interestingly, there also seems to be a link between the faculty of vision and cognition: sight meanings extend to meanings relevant to attention and cognitive process such as deduction, gaining knowledge and attention but this is not true for other senses (San Roque et al., 2018). Therefore, contrary to the conceptual naturalness explanation, visual perception as an information source appears to be a highly salient concept and should be a 'natural' candidate for linguistic marking and acquisition.

Since conceptual naturalness does not adequately capture the observed learnability patterns, one could interpret Saratsli et al.'s evidence as pointing towards a pragmatic bias: learning to mark an indirect, potentially unreliable information source might be easier than learning to mark a source directly associated with perceptual experience because of the motivation to mark what seems to be more communicative valuable and noteworthy. Informativeness drives languages to mark pragmatically notable and unexpected information

(Grice, 1975; Greenfield, 1979). Indirect information sources, with third-person reports being the most indirect source type, diverge from one's perceptual experience and tap on epistemic vigilance – a cognitive tool used so as to avoid being misinformed (Sperber, Clement, Heintz, Mascaro, Mercier, Origgi & Wilson, 2010). As a consequence, marking those sources can express doubt and lack of direct, trustworthy evidence for an event, a pragmatically noteworthy property in communication (Wiemer, 2018). By contrast, visual perception as an information source has a privileged status as giving reliable access to information, such that marking it through a linguistic tool might be potentially redundant (Dancy, 1985; Papafragou et al., 2007; Aikhenvald, 2018; Wiemer, 2018).

Despite the plausibility of the pragmatic explanation, the Saratsli et al. data do not uniquely support it. In that study, for the inference scenarios, the speaker had access to very strong visual clues as a basis for their reasoning about the event, bringing those scenarios very close to the visual experience events. Research findings suggest that the more determinate the visual clues for inference are, the more likely people are to describe or remember the inferred events as seen (Johnson, Hashtroudi, & Lindsay, 1993; Ünal, Pinto, Bunger & Papafragou, 2016). Therefore, it is still unclear whether participants' lower accuracy with the Visual evidential system in Saratsli et al. was motivated by pragmatic factors or the difficulty of distinguishing visual from inferential scenarios in the experiments.

The aim of the current study is to explore the origin of the learnability asymmetries in the domain of evidentiality. We use the same Artificial Language paradigm as Saratsli et. al. (2020) but test the learnability of only two evidential systems: one that only marks reported information (Reportative System) and one that only marks visual perception (Visual System) as the speaker's information (Table 1). If visual information sources are unlikely to be marked morphologically for pragmatic reasons, the asymmetry observed in Saratsli et al. should persist in the current paradigm; otherwise, it should vanish.

Table 1. Evidential systems

	Speaker's Information Source	
Evidential System	Visual (Visual Perception)	Reportative (Testimony from Others)
Visual	*-ga*	-
Reportative	-	*-ga*

3. Experiment
3.1. Participants

Sixty-four adult participants were recruited. They were either undergraduate students at the University of Delaware that participated for course credit (n = 58) or individuals that were recruited through Amazon Mechanical Turk (n = 6). All participants were native speakers of English and none of them reported speaking an additional language at home or a language that included grammatical evidentials.

3.2. Materials and Procedure

Our stimuli were 42 videos in two versions, with each version corresponding to a type of information access (Visual or Reportative). Three characters were involved in each scenario and their roles remained consistent across the different events shown. One character that performed an action ("the Agent"), a second character that either fully witnessed this action (Visual Access version) or was informed about what happened with no visual access to the event (Reportative Access version). At the end of the video, this second character ("the Speaker") turned to the camera and described what happened. The third character manipulated the Speaker's access to the event by either allowing her to watch what happened or by blocking her visual access throughout the event. The event setting was also kept identical across the different videos with the Agent and the Speaker sitting at the opposite sides of a table while the third character was standing behind the Speaker.

Each event was filmed in two versions depending on the Speaker's Access to the event (Visual or Reportative). This allowed us to create two counterbalancing lists by rotating the Speaker's access to the event (i.e., if a certain video in list 1 showed the Speaker having Visual Access to the event, the same video in list 2 would show the Speaker having Reportative access to the same event). For each evidential system, there were four different randomized presentation lists and participants were randomly assigned to one of the two evidential systems and to one of the four corresponding presentation lists of that evidential system.

Figure 1. Sample screenshots from versions of a scenario in which a character gained access to an event of someone lighting a lamp either through visual access (A) or verbal report (B)

An example of an event can be seen in Figure 1. For the Visual Access (Panel section A), the Speaker had continuous direct visual access while the Agent performed the event (she lit a lamp, panels A2-A4). To make these videos comparable to the Reportative Access ones, the Speaker's eyes were blocked by the third character in the beginning of all the Visual Access events (A1) but then the Speaker gained Access to the complete event (A2-4). For the Reportative Access (Panel section B), the Speaker's eyes were blocked throughout the event by the third character (B1-3). After the Agent had completed the event and took the materials away from the table, the third character uncovered the Speaker's eyes and was shown whispering to her (B4). For both access types, the video ended with the Speaker turning to the camera to describe what happened. At that time, a speech bubble appeared, containing a sentence in the target artificial language and remained on the screen for approximately 8 seconds before the next video started.

This artificial language shared the English lexicon but followed a Subject-Object-Verb word order and lacked determiners. A novel evidential morpheme, ga, was attached at the end of the verb to mark the character's access to the event (e.g., *She lamp litga*). We constructed two evidential systems (Visual and Reportative) depending on the type of the type of information source that was marked with *ga*; within each system, the events corresponding to the other type of access were described using plain, unmarked sentences (e.g., *She lamp lit*).

Following the Artificial Language Learning paradigms, our experimental procedure started with a Training Phase exposing participants to the events and the use of the artificial language and proceeded with a Testing Phase, in which participants' ability to use (Production Task) and interpret (Comprehension Task) the novel morpheme was assessed. In the beginning of the experimental session, participants were provided with a detailed description of the setting of the events and the role of each character.

Subsequently, they were given a still image of the three characters in the visual setting was displayed in an effort to familiarize participants with the content of the stimuli before the actual videos began. Participants were then provided with the instructions for the Training Phase, including details about the artificial language to which they would be exposed and what they needed to do. More specifically, they were told that “the characters will be speaking an alien language that shares some words with English but it is different in several ways. One difference is that the language includes a special marker: "ga".” Their task was to pay attention to when "ga" appears in order to try and figure out what it means. Before the videos started, participants were also informed that there would be a second part in which their understanding of where ga appeared based on its meaning would be assessed. The Training Phase included 10 videos in total, 5 videos for each Access type.

After this phase, participants continued with the Production and subsequently with the Comprehension Task. For the Production Task, participants watched 8 new videos, 4 videos for each type of Access (Visual or Reportative). The setting and structure of the videos displayed was identical to the videos shown in the Training Phase but when the speech bubble appeared at the end of the video, there was a gap next to the verb where the evidential marker could be placed and participants had to decide whether the marker should be used or omitted. For each clip, a textbox was provided in which they were asked to type in either the verb with the marker (e.g., *litga*) or only the verb (e.g., *lit*) if they thought that no marker is needed in order to complete the speech bubble. Before the actual task began, participants were shown a sentence example that did not appear in the actual task so as for them to get a more precise idea of what their answer should be.

For the Comprehension task, participants were shown 24 new videos, 12 per each Access type. For half of the events the Speaker erroneously used the morpheme *ga*, either by omitting the morpheme when it should have been used or by using it for the wrong type of access. For the remaining half of the scenarios, the use of the morpheme was correct. Participants were asked to type in either “yes” or “no” depending on whether they thought the character was correctly using the marker or not. After completing the Comprehension Task, participants were asked to provide a brief description of what they thought the marker *ga* meant and when it was used.

3.3. Results

Participants’ responses were coded as a binary outcome variable (using 1 for a correct response or 0 for an incorrect response), separately for each task. Performance for each task can be seen in Figure 2. A logistic mixed-effects modeling was used for the data (Baayen, Davidson, & Bates, 2008; Baayen, 2015), running a generalized binomial linear mixed effects model (glmer) of the lme4 package due to the presence of categorical variables. For each of the two tasks, the model included participants' accuracy as the dependent variable and the type of evidential system (Visual, Reportative) as a fixed predictor along with random intercepts for Participants and Items. Since the fixed predictor of System only had two levels, its effect was assessed with one planned comparison between the Reportative and the Visual systems (contrast coding: -.50,.50). The analysis was performed using the R Project for Statistical Computing (R Development Core Team, 2018).

For the Production task, including the fixed predictor in the model significantly improved the model fit based on a chi-square test of the change in -2 restricted log likelihood ($\chi 2$ = 10.58, p = .001, Table 2). Participants showed higher accuracy rates for the Reportative compared to the Visual System ($M_{Reportative}$, = 0.79, M_{Visual} = 0.60). For the Comprehension task, we obtained similar results, with the factor System significantly improving the model fit ($\chi 2$ = 16.59, p< .001, Table 2): the Reportative System yielded higher accuracy rates compared to the Visual System ($M_{Reportative}$, = 0.85, M_{Visual} = 0.54).

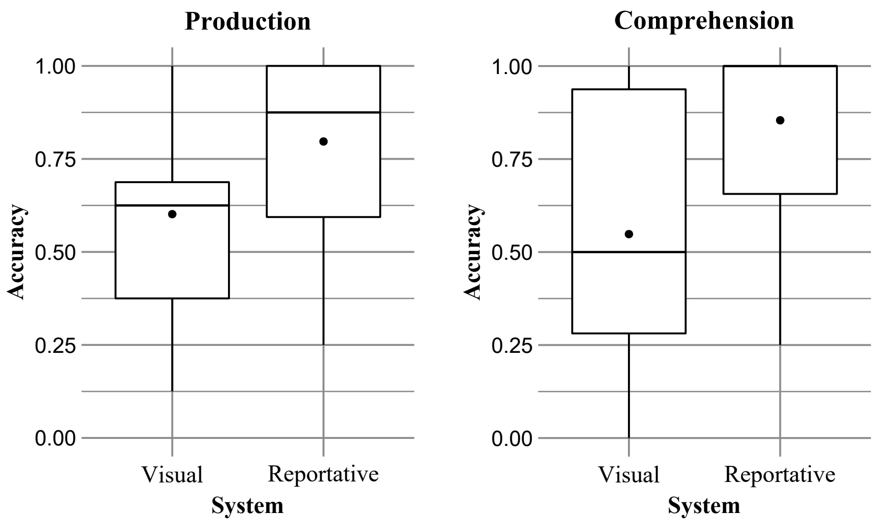

Figure 2. Accuracy score distribution, median (horizontal bar) and mean (dot) for each Evidential System in the Production and Comprehension tasks

Table 2. Parameter estimates for Accuracy. Significance levels: . .1, * .05, ** p < .01, *** p < .001

Effects	Estimate	SE	z
Production Task			
Intercept	1.18	0.21	5.41 ***
System (Reportative vs. Visual)	-1.26	0.39	-3.23 **
Comprehension Task			
Intercept	2.70	0.54	5.00 ***
System (Reportative vs. Visual)	-3.82	0.98	-3.87 ***

Participants' answers to the question about the meaning and use of the novel marker *ga* align with the accuracy rates observed in the two tasks. Ten of the 32 participants that were exposed to the Visual System correctly associated the morpheme with visual access to the event, specifically mentioning the verbs *see*, *watch* and *look*. Additionally, one participant associated the marker only with the absence of whispering by the third character. Eight participants mistakenly associated the marker with the opposite (i.e., Reportative) access. The remaining 18 participants associated ga with irrelevant, non-evidential meanings (e.g., they mentioned other morphemes such as *the*, *a*, *-ed*, or other kinds of meanings, such as event completion). Of the 32 participants exposed to the Reportative System, a majority of 23 participants offered appropriate conjectures about the meaning of ga: 15 participants associated the marker with the Speaker not knowing about the event and being told about what happened, 7 focused on the Speaker's lack of visual access, and the remaining 2 associated the marker with uncertainty and secret action. The rest of the participants provided meanings unrelated to evidentiality and speaker's information source.

3.4. Discussion

Across languages, distinctions that are more prevalent have long been considered to be easier to learn. Support for this hypothesis has come from several Artificial Language learning studies in the domains of syntax, morphology and phonology (see Section 1). However, no extensive empirical findings exist to support this idea in the domain of semantics. Here, following our prior work (Saratsli et al., 2020), we explored whether, and most importantly, *why* certain semantic distinctions are more common and more learnable than others focusing on the domain of evidentiality. More specifically, we experimentally compared the learnability of evidential semantic distinctions that are most frequently encountered (reported information) and those least frequently encountered (direct visual information). Our goal was to test whether, even in a simple testing context, pragmatic considerations would promote reportative over visual conjectures for a novel evidential morpheme.

Our results show that even in a contrastive setting with only two information sources to be considered, learning the most typologically common evidentiality system, the Reportative system, was easier compared to marking the less prevalent Visual evidential system. This pattern was confirmed by participants' explicit conjectures about what the marker meant: participants exposed to the Reportative System were more likely to explicitly associate the marker with the correct evidential meaning compared to participants exposed to the Visual System.

This pattern is successfully predicted by accounts positing that the most cross-linguistically prevalent semantic distinctions should be easier to learn (e.g., the Typological Prevalence Hypothesis; Getner & Bowerman, 2009). However, unlike what past accounts have suggested, the explanation for both the typological and the learnability asymmetry lies not in the conceptual naturalness of the relevant evidential distinctions but in the pragmatic motivation for marking certain kinds of evidential meanings over others. The tendency to flag less reliable information sources is consistent with developmental findings according to which children choose to preferentially learn from reliable than unreliable speakers (Koenig & Harris, 2005; Jaswal, 2010). Lastly, this approach has affinities with research findings that speak for the role of communicative pressures on the organization of the lexicon across different languages (Kemp, Xu & Regier, 2018; Fedzechkina et al., 2016).

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