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Exploring syntactically encoded evidentiality

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ABSTRACT

The most recent studies on the acquisition of evidentiality, be it morphologically or syntactically encoded, have argued that the comprehension lag detected is due to factors having to do with others' authority or mental perspective, where "others" stands for other individuals involved in the experiment in various manners (e.g., the experimenter or someone in the props). However, these studies have yet to detect the age at which children eventually align with adults in comprehending the grammatical structure encoding the evidential interpretation when it is syntactically encoded. The comprehension study reported in this article has taken the aforementioned factors into consideration and has involved a large number of Greekspeaking children between second and fifth grades, along with an adult control group, to investigate syntactically encoded evidentiality. The results suggest that children align with adults in mapping source of evidence to sentence type during fourth grade, when they are 9 years old or older, suggesting that there should be additional factors behind the delayed comprehension of evidentiality. It is argued that these factors are mainly grammatical, and, most importantly, they arise to a larger extent in languages that encode evidentiality in the syntax

1. Introduction

This article is concerned with evidentiality in Greek, a language that encodes evidentiality in the syntax. Previous acquisition studies have focused predominantly on languages encoding evidentiality morphologically. These were the first to reveal that comprehension of grammaticalized source of evidence systematically lags behind production (see Aksu-Koç 1988; Aksu-Koç, Ögel-Balaban & Alp 2009; Papafragou et al. 2007; Ozturk & Papafragou 2016), in the sense that children have earlier control over the morphemes that realize the evidential interpretation in production than in comprehension. A few recent studies investigated how children acquire evidentiality when it is encoded syntactically and, on the basis of naturalistic data, argue that the asymmetry reported in the previous research is replicated by one such language, English. The naturalistic data in the latter studies were taken to show that children are successful in producing evidential constructions at a very early age (see Rett & Hyams 2014), by contrast to subsequent comprehension studies, which failed to obtain similar results from children of similar or even older ages (see Winans et al. 2015). Ünal & Papafragou (2016), through their study of Turkish, have more recently explored methodological and psycholinguistic factors that might be responsible for the comprehension lag. The authors conclude that this lag "[...] is not explained by methodological factors, but seems to be due to the psycholinguistic process of linking evidentials to others' knowledge sources." The current study assesses this view-that the productioncomprehension asymmetry arises from difficulties mainly having to do with others' mental perspective (Ünal & Papafragou 2016) or the experimenter's authority and other similar factors in Winans et al.'s (2015) terms. It aims to investigate when children align with adults in comprehending the structures

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Received 02 February 2021 Accepted 27 May 2022 that encode evidentiality in the syntax when the factors that have been considered responsible for the production-comprehension asymmetry are controlled for and explores what these findings contribute to what we know about the acquisition of syntactically encoded evidentiality and of evidentiality more generally.

The study involves a large number of typically developing Greek-speaking children, 100 children in total divided in four groups, of older ages than usually investigated—from second to fifth grades, spanning from 7- to 11-years-old, as well as 30 adults. It provides solid evidence that children align with adults in comprehending mapping of the evidential interpretation to a particular syntactic structure after the age of 9. If it is indeed correct that production of the same constructions occurs much earlier, it suggests that there should be additional factors besides others' authority or others' mental perspective that are responsible for the comprehension lag observed. We claim that there are indeed additional factors posing difficulties in the acquisition of syntactically encoded evidentiality. These are linguistic factors, having to do with the structures that are employed to encode evidentiality, and arise to a larger extent than has been assumed until now.

The article proceeds as follows. Section 2 discusses the various means, morphological or syntactic, via which evidentiality is encoded cross-linguistically, with particular focus on Greek. Section 3 presents results from previous research on the acquisition of morphologically and syntactically encoded evidentiality. Section 4 describes in detail the structured experiment we conducted, and section 5 presents the results. Section 6 discusses the findings, and section 7 concludes.

2. Evidentiality

2.1. Evidentiality cross-linguistically

The term *evidentiality* refers to encoding in language the source of information associated with an utterance.¹ Tariana, for instance, an Arawak language spoken in Brazil that was investigated by Aikhenvald (2004), marks evidentiality on the basis of whether speakers have direct or indirect access to the event they report. Moreover, Tariana offers the possibility for further, fine-grained, distinctions within the direct and indirect dimensions; hence in (1a) the evidence is direct, and the speakers saw what they are reporting, i.e., they saw Cecilia scolding the dog, while in (1b) they heard her. (1c) and (1d), on the other hand, instantiate indirect evidence, either reported to the speaker by someone or inferred by the speaker respectively (Aikhenvald 2003).

a.	Ceci t∫inu-nuku	du-kwisa- ka
	Cecilia dog-TOP.NOM.A/S	3SGF-scold-REC.P.VIS
	'Cecilia scolded the dog.' (I	saw it)
b.	Ceci t∫inu-nuku	du-kwisa- mahka
	Cecilia dog-TOP.NOM.A/S	3SGF-scold-REC.P.NONVIS
	'Cecilia scolded the dog.' (I	heard it)
с.	Ceci t∫inu-nuku	du-kwisa- pidaka
	Cecilia dog-TOP.NOM.A/S	3SGF-scold-REC.P.REP
	'Cecilia scolded the dog.' (I	learned it from someone else)
d.	Ceci t∫inunuku	du-kwisa- sika
	Cecilia dog-TOP.NOM.A/S	3SGF-scold-REC.P.INFR
	'Cecilia scolded the dog.' (I	inferred it)
	a. b. c. d.	 a. Ceci t/inu-nuku Cecilia dog-TOP.NOM.A/S 'Cecilia scolded the dog.' (I) b. Ceci t/inu-nuku Cecilia dog-TOP.NOM.A/S 'Cecilia scolded the dog.' (I) c. Ceci t/inu-nuku Cecilia dog-TOP.NOM.A/S 'Cecilia scolded the dog.' (I) d. Ceci t/inunuku Cecilia dog-TOP.NOM.A/S 'Cecilia scolded the dog.' (I)

According to Aikhenvald (2004), one quarter of the world's languages have an evidential system grammaticalized by means of a morpheme. Although the morpheme that marks evidentiality attaches to the verb in Tariana, it may attach to the verb or the noun in Quechua (Murray 2017):

¹And see Izvorski (2007) for the view that direct vs. indirect source of evidence information can be captured by speaker's commitment or not to the truth respectively.

(2)	a.	Parashan- cha	
		rains-INFR	
		'lt must rain.'	(l infer it)
	b.	Juan- mi	chayamun.
		Juan-VIS	arrived
		'Juan arrived.'	(I saw it)

Other languages that mark evidentiality morphologically are Bulgarian, Korean, Turkish, and Tibetan. Often, the evidentiality marker may encode some additional grammatical property, e.g., aspect in Bulgarian and Turkish, among other languages (Izvorski 1997).

English has standardly been considered a language that encodes evidentiality lexically, e.g., via perception verbs or adverbs (see Papafragou et al. 2007):

(3)	a.	I saw/heard John sing.
	b.	John was allegedly singing.

Nevertheless, the following two English sentences do not carry the same information in terms of source of evidence: (4a) can be uttered regardless of whether the speaker has direct evidence about John winning the race, that is, regardless of whether the speaker saw or heard John winning, and (4b) can only be uttered if speakers have direct evidence of the event.

(4)	a.	It seems/looks/sounds like John won the race.
	b.	John seems/looks/sounds like he won the race.

Such pairs of sentences have been discussed in the syntactic and semantic literature, and they are known as *copy raising* structures (Rogers 1971, 1973; Postdam & Runner 2001; Landau 2009). Asudeh & Toivonen (2012) provide a detailed analysis and draw attention to differences between *seem* and the rest of the verbs in (4), among other things, while pointing out that *seem* in copy raising is not the same as in the standard raising structures in that neither alternative (raised or unraised) is restricted to direct perception. By focusing on copy raising pairs such as in (4), Rett & Hyams (2014) consider the interpretive difference between (4a) versus (4b) a difference in terms of evidentiality, which is thus taken to be encoded syntactically in English.

2.2. Evidentiality in Greek

In Greek too, there is no morphological device to mark source of evidence (see Tsangalidis 2012). Previous works on the topic in fact hold that, with the potential exception of a few lexical items, Greek does not encode source of evidence in grammar in the overall.

Aikhenvald (2004) notes, quoting Friedman (2003), that Greek is rather unusual for a language spoken in the Balkans, especially in light of the easiness of diffusability of evidentials, in that it does not possess evidential categories. Joseph (2003) conjectures that evidentials did not diffuse into Greek because of sociocultural reasons and the attitude of the Greeks toward their language. Aikhenvald adds that the Greek adverb *taha* 'maybe, it seems, apparently,' often referred to as a "hesitation" marker, although treated by Ifantidou (2001) as a "weak" evidentiality marker, has nothing to do with grammatical evidentiality, a statement with which we agree. Friedman (2003) adds that any language has lexical means for expressing a speaker's hedging, doubt, and attitude to information, and Greek has such a particle—*leei* 'one says,' meaning 'reportedly, allegedly'—which can also acquire mirative extensions. According to Aikhenvald (2004), this particle could be at most an incipient reported evidential, comparable to Colombian Spanish *dizque*.

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In what follows we present novel evidence challenging the consensus in the aforementioned literature on Greek, which, however, had admittedly only considered lexical or morphological evidentiality strategies. The following examples show that, in a manner similar to English, different types of embedded sentences may perform the role of encoding source of evidence in Greek. Thus, with an indicative embedded sentence, introduced by the complementizer *oti*, (5a), the speaker may express either that they saw Nikos leave or that they did not see him leave but inferred that he left by seeing his belongings missing, for instance. The latter interpretation realizes a clear case of the (default) evidential, i.e., indirect evidence interpretation, encoded in grammar via a certain type of clause type, the indicative. The sentence after the perception predicate may alternatively be a relative, formed with a distinct complementizer, pu (5b). The relative sentence may only be uttered if speakers saw the event or the subject of the clause, that is, *someone*, leave in the case at hand.

(5)	a.	Ida	oti kanios	efiae.
(3)	u.	744	ou napios	chge.
		saw.1SG	i that someo	ne.NOM left.3SG
		'l saw th	nat someone	left.'
	b.	Ida	kapion	pu efige.
		saw.1SG	i someone.A0	CC that left.3SG
		ʻl saw so	omeone leave	e.'

Let us now look more closely at the aforementioned types of sentences, as they will be employed crucially in our study to assess source of evidence. Sentences such as (5b) are ambiguous between standard relatives and pseudo-relatives (Cinque 1995, Angelopoulos 2015). Pseudo-relatives differ from standard relatives in that only the latter describe an individual; whereas the first describe an event/situation. This ambiguity in interpretation is reflected in their behavior with respect to the reference of an associated demonstrative pronoun. Under the standard relative usage, this pronoun refers to an individual with the same phi-features as the head of the relative (6a). On the other hand, only a neuter pronoun can be used in pseudo-relatives, and it crucially refers to the event or situation that the sentence describes (*someone leaving*, in this case), (6b), (see Moulton & Grillo 2015 for these diagnostics).

(6)	a.	Aftos _i pu ida	itan kapios _i	ри	efige.
		he that saw.1SG	was someone.NON	1 that	it left.3SG
		'Who I saw was sor	meone that left.'		
	b.	Afto _i pu ida	itan [kapion	ри	efige] _i .
		this that saw.1SG	was someone.ACC	that	t left.3SG
		'What I saw was so	meone leaving.'		

In this respect, pseudo-relatives behave like indicative *oti*-clauses, which also express events/ situations, and can be referred to by the neuter demonstrative *afto* in a cleft construction as in (7).²

(7)	Afto _i pu ida itan [oti kapios efige] _i .
	this that saw.1SG was that someone left.3SG
	'What I saw was that someone left'.

On the other hand, the following sentences show that a verb such as *apohereto* 'say goodbye', which can only take a standard relative as its argument, (8a), does not behave the same: a pronoun can only refer to the head of the relative, (8b), while (8c) is ungrammatical, unlike (6b) earlier.

²We have used perception verbs in the preceding discussion for easiness of exposition but also because they are the prototypical verbs that have been discussed in the literature on pseudo-relatives and source of evidence (Moulton & Grillo 2015). It should be noted, however, that there are more verbs that can take this clause type as argument. One such verb is *dixno* 'show,' which we have systematically included in our experimental items. As we discuss later, the indicative and relative clauses after this verb express the exact same meanings as the ones discussed here with the perception verb *see*.

(8)	a.	Apoheretisa kapion pu efige. greeted.1SG someone.ACC that left.3SG 'I greeted someone that left.'
	b.	Aftos; pu apoheretisa itan kapios; pu efige. he that greeted.1SG was someone.NOM that left.3SG 'Who I greeted was someone that left.'
	c.	*Afto _i pu apoheretisa itan [kapion pu efige] _i . this that greeted.1SG was someone.ACC that left.3SG 'What I greeted was someone that left.'

Moulton & Grillo (2015) point out that many Romance languages allow a particular type of clausal constituents under perception verbs, known as pseudo-relatives, which express *transparent, epistemically neutral direct perception*. We argue that this is also the case with the relative sentences of Greek that are employed in our tasks. On the other hand, indirect perception reports are expressed by finite CPs in the same languages (see Moulton & Grillo 2015 and references therein), and the same holds for Greek.

With this background in mind, we will turn our attention in the next section to the literature on how children acquire the means to encode evidentiality in the languages that have been investigated so far.

3. Acquiring the means to encode evidentiality

There is a long line of research on children's acquisition of evidentiality—on how and when children understand and employ the appropriate grammatical means to encode direct and indirect source of evidence. Two general patterns seem to emerge repeatedly: (i) use of the appropriate means to encode direct evidence precedes use of the appropriate means to encode indirect by at least a year, in both production and comprehension studies. Moreover, errors are in the form of replacing markers that encode indirect evidence with those encoding direct; and (ii) target performance on comprehension experiments follows target performance on production experiments. Finally, results of experimental studies show later acquisition when compared to spontaneous speech data, also by a year or two.

3.1. Morphologically encoded evidentiality

Turkish is the first language that was investigated in terms of children's acquisition of evidential morphology. In a seminal study, Aksu-Koç (1988) asked 3- to 6-year-old children to describe events acted out with toys, which children either observed directly, or observed directly in the beginning and in the end of the event, and had to infer the process. The results showed that children from 3 to 3 and a half years old controlled the semantics and pragmatics of the direct morpheme (-di), with almost 90% target performance, where the same performance for the indirect morpheme (-mis) was achieved at age 4. Successful use of -mis to report something was observed at age 4 to 4 and a half (Aksu-Koç 1988; Aksu-Koç & Alp 2005). Use of -dir to indicate a deduction based on previous knowledge was not stabilized before 4 to 4 and a half either (Aksu-Koç 1988). In comprehension studies children were asked to identify the speakers of utterances marked with -di versus -mis and with -di versus -dir in association with picture stories. The results confirmed the pattern of production studies, but a similar level of target performance was achieved about a year later: Success in matching -di verbs with characters who perceived the event directly reached 80% target performance at about 4 and a half; at the same age correct identification for -mis or -dir with characters who talked on the

basis of inference from evidence or from previous knowledge reached 40% to 50% (Aksu-Koç 1988; Aksu-Koç 2000; Aksu-Koç & Alici 2000; Aksu-Koç et al. 2005). Ozturk & Papafragou (2007) obtained similar results from Turkish-speaking children between ages 5 and 7 for the di and -miş morphemes they investigated. Children marked with -di the events they saw 98% of the time; they marked with -miş events they inferred 52% of the time. A comparison between the production and the comprehension tasks confirmed that children performed better in the production tasks compared to comprehension. Other studies of languages with morphologically encoded evidentiality replicated the picture: Papafragou et al. (2007) investigated the Korean -e and -tay morphemes, encoding direct evidence and hearsay respectively, and concluded that children's understanding of the morphemes are not quite in place at age 4. Yet between 3 and 4 years of age Korean children seem to use correctly these morphemes in production studies. On the other hand, the comprehension studies of Tibetan children by de Villiers et al. (2009) led the authors to conclude that children do not have the full system of evidentials in place even after the preschool years.

Aksu-Koç, Ögel-Balaban & Alp (2009) suggested that production experiments, even when successfully set, may not always create the state of consciousness that constitutes the appropriate cognitive context, with the consequence that children lag behind spontaneous speech performance. Comprehension experiments, on the other hand, pose demands on children's working memory (e.g., keeping the linguistic form in memory), role taking abilities, and children's ability to coordinate temporal and informational perspectives. By contrast, comprehension in natural discourse is not equally demanding, Aksu-Koç, Ögel-Balaban & Alp (2009) believe, as the speaker is present in the discourse, and the child can directly interpret the point of view signified by the evidentiality marker.

Ünal & Papafragou (2016) focus on the production-comprehension asymmetry in acquiring evidential morphology with the aim to attain a better understanding of it and evaluate the two types of explanations that have been proposed for this asymmetry in language acquisition. The first line of explanations is a methodological one: According to it, delay in comprehension is due to factors that are extrinsic to the language domain under investigation (e.g., they are metalinguistic, or they overload children's domain-general processing) and should disappear if the tasks reduce challenges or accommodate children's processing abilities. According to the second type of explanations, the psycholinguistic one, the processes involved in comprehension and production are not just the same computations, executed in the reverse order, with comprehension overloading the system more than production. Instead, comprehension is some type of mental guessing game, in which the listener unpacks the meaning of the incoming linguistic expression and integrates the information with the information provided by the context and the speaker's intentions. In production, on the other hand, the speaker plans a message to convey the intended meaning, and although the hearer's needs play a role in this process, the speaker plans and executes an utterance based on their resources and perspectives in mind. After running a series of experiments, in which task demands were gradually reduced yet no improvement in comprehension of evidentiality ensued, Ünal & Papafragou (2016) concluded that it is the latter line of reasoning that is more plausible for understanding the delay in comprehension of evidential marking. In particular, after running their last task (experiment 5), in which children were asked to assess how evidence and knowledge are linked outside of language, for themselves and for others, the authors argue that the comprehension delay seems to be due to the psycholinguistic process of linking evidentials to others' knowledge of source of evidence, confirming the findings of their previous tasks in the same study in that the methodological explanations are not on the right track. Concretely, the authors found that children had difficulty reasoning about others' evidence in nonlinguistic tasks, but the difficulty decreased when the tasks involve accessing their own source of evidence. The experiment of Ünal & Papafragou (2016) is immediately relevant to our study, which, as will be discussed in what follows, was designed so that participants rely on their own source of evidence/mental perspective. Before we present it, we will present the studies of Rett & Hyams (2014) and of Winans et al. (2015), which constituted the motivation for ours and share with it the component of grammar on which evidentiality is mapped—syntax.

3.2. Syntactically encoded evidentiality

By focusing on pairs of sentences such as in (4), Rett & Hyams (2014) proposed that evidentiality may be expressed syntactically in English. Moreover, unlike in several languages that express evidentiality morphologically, but the same morpheme encodes additional grammatical properties, e.g. tense/aspect, (4a) and (4b) differ only in terms of source of evidence. On the other hand, as they note, evidentiality is encoded optionally in English.³ Rett & Hyams analyzed the data of 45 American English-speaking children between the ages of 2 and 7 from the CHILDES database. They found 70 utterances with the verbs *look, sound*, and *see* (Perception Verb Similatives, PVS, in their terms) in the relevant constructions, 55 of which were unambiguous in terms of their syntax and their source of evidence. Of these 55 utterances, 21 had a raised subject and the rest 34 had their subjects unraised, as shown in Table 1 (Table 4 from Rett & Hyams 2014).

As Table 1 shows, the 34 instances of unraised subjects were used either for direct, 20/34, or indirect, 14/34, evidence by children. On the other hand, utterances with raised subjects were employed exclusively for direct evidence, 21/21. Rett & Hyams (2014) take these findings to suggest that English-speaking children, from very young ages, know that the raised option of PVSs require a subject that is the source of perception, whereas the unraised alternative may encode indirect perception (evidence). In addition, Rett & Hyams examined data of standard raising constructions with *seem* as in (9):

(9)	a.	John seems to have won the race.
	b.	Bill seems to be sick.

Table 1.	PVSs a	and evic	lence	source	in	English-	-speaking	children.
						<u> </u>		

	Syntax		
Evidence	Raised	Unraised	Total
Direct	21 (52%)	20 (49%)	41
Indirect	0	14 (100%)	14
Total	21	34	55

Table 2. Standard raising and evidence source in English-speaking children.

	Syr	itax	
Evidence	Raised	Unraised	Total
Direct	12 (75%)	1 (33%)	13
Indirect	4 (25%)	2 (66%)	6
Total	16	3	19

³It is not entirely clear to us what "optionally" means, other than that the unraised variant of the relevant sentences is associated with either direct or indirect evidence.

These sentences differ from the raised variants of copy raising in (4) because, as already mentioned, they are equally acceptable in contexts of direct or indirect evidence in the adult grammar. Rett & Hyams (2014) discovered, by using production data from CHILDES again, that the same children allow indirect evidence with the raised version of *seem*, (9). This is shown in Table 2, which is Rett & Hyam's Table 7.

The findings in Table 2 are used to confirm that the findings of Table 1 are not due to some tendency children have to associate raising with direct evidence. Rather, children seem to know that only in the copy raising sentences the variant with the raised subject cannot encode indirect evidence.⁴

In subsequent work, Winans et al. (2015) undertook a comprehension study of syntactically encoded evidentiality in English, carried out with 4- to 6-year-old children and adult controls. Participants were administered a felicity judgment task in which they were presented with pictures and a puppet that, according to the experimenter, was learning to describe pictures. Children and adults heard either version of the copy raising sentences (PVSs) in (4) from the puppet and were asked whether the sentences they heard matched the (evidence provided by the) pictures. The pictures provided either direct or indirect evidence. Adult speakers confirmed the contrast in (4) and accepted raised sentences with an indirect evidence scenario in the pictures 23% of the time, whereas they accepted them 93% of the time with a direct evidence scenario. On the other hand, they accepted unraised sentences with indirect evidence scenario 77% of the time and with direct evidence 91% of the time. Hence raised sentences were much more likely to be accepted with a direct evidence scenario than with indirect, while indirect evidence scenarios were much more likely to be accepted by sentences with unraised subjects. Children showed no such correlation and no significant effect of age; in particular, while percentages changed slightly across the age groups, the difference among them was minimal and did not reach significance. Most importantly, children equally accepted a raised sentence with direct evidence as with indirect evidence.

The authors point out the production versus comprehension asymmetry also found in other studies —that although children even from age 2 used raised sentences in a felicitous manner, at least in naturalistic data—they were not able to comprehend in the relevant experiments that form matches which source of evidence up to much older ages. They hold that this asymmetry seems to be independent of the methodology used in the various comprehension experiments across languages and the type of language investigated. Winans et al. (2015) point to a number of factors as potentially responsible for the low performance of the children they assessed on their comprehension task. These factors are, first, the authority of the speaker (in their case, of the puppet that utters the sentence to be assessed), which children do not seem to be able to challenge easily. Then the tasks rely on the participant interpreting the evidential on the basis of the immediate context only, while evidential information is generally not discourse-bound, and this is something else that children cannot overcome. Finally, as Winans et al. claim, children may ignore the matrix subjects of the test sentences in English, with the consequence that what is left of the sentence is unmarked for source of evidence. The authors suggest that future experiments should avoid these confounds, and the study to be reported in the remainder of the article has indeed tried to do so.

4. Methodology

As was demonstrated in section 2, Greek encodes evidentiality syntactically. Thus, when the sentential complement of a perception verb such as *see*, for instance, is in the indicative, the evidence the speaker has with respect to the content of this sentence can be either direct or indirect—the speaker does not have to have seen the event while occurring but could as well infer it. On the other hand, when the

⁴Unlike with PVSs, however, where numbers and percentages are reported per age group, there is no information as to the age at which these four instances of standard raised *seem* with indirect evidence were attested (see related discussion in section 6.1.).

Table 3. Chi	ldren participa	ants.		
Grade	Ν	Mean age	Age range	SD
2	25	7;09	7;00–8;04	0.35
3	25	8;10	8;03–9;10	0.46
4	25	9;09	9;04–10;04	0.32
5	25	11	10;03–11;06	0.36

complement is a relative sentence, the speaker has to have direct perception of the event reported by the embedded sentence. In this work we investigate when Greek-speaking children attain this knowledge, by focusing on the comprehension of indicative and relative embedded sentences—sentences such as (5a) and (5b).

4.1. Participants

The participants of the study were 100 Greek-speaking children and 30 adults. The children were divided into four groups of 25 each, according to their elementary school grade (Table 3). They were recruited from public schools in Patras, Pireaus, and Neapolis (Lakonia). Adults were, for the most part, students from the various Departments of the University of Patras, except from the Departments of Linguistics and Speech-Language Therapy.

4.2. Materials

To investigate when Greek-speaking children comprehend the difference that the embedded clause type makes in terms of encoding source of evidence, we constructed the four conditions in (10). These involve indicative and relative sentential complements of the verb *dixno* 'show,' each of which is associated with direct and indirect perception of an event depicted in a three-picture set. Of the four conditions, (10b) is infelicitous because embedded relative sentences cannot encode indirect evidence in the adult grammar. We used the verb *show(s)* to embed indicative or relative sentential complements, instead of some run-of-the-mill perception verb, because it allows for a subject that does not refer to an individual (the subject is *the picture* in the actual testing sentences, (11). As a result, children do not have to consider some (other) individual's source of 3434TPor mental perspective for their responses but only their own. Moreover, the fact that *show* is not a perception verb, e.g., *see*, has the additional advantage of rendering the mapping of source of evidence to syntactic structure more direct.

(10)	a. Indicatives – Indirect evidence	c. Indicatives – Direct evidence
	b. Relatives – Indirect evidence	d. Relatives – Direct evidence

Administration of the experiment proceeded as follows: First, participants were familiarized with the notion of direct and indirect evidence by being shown two pairs of pictures (see Figure 1). For a pair such as in Figure 1, for instance, they were told that in the left picture someone/the boy is painting, while in the right picture someone/the boy has already painted a picture, but we don't see him because he left the room to go somewhere.

We then proceeded to the main experiment. Participants were shown sets of three pictures, two of which were open; the third was hidden (Figures 2a–3a). One of the two open pictures was a filler, in the sense that it was unrelated to the story provided by the sentences participants heard. Of the related open pictures, one was depicting indirect evidence (Figure 2a) and the other direct (Figure 3a). On the other hand, the hidden picture depicted the opposite source of evidence respectively—direct evidence in Figure 2b and indirect evidence in Figure 3b.





Figure 1. Pair of familiarization pictures.

When participants were shown the pictures in Figure 2a, they received the instruction in (11a) followed by (11b) and (11c). This was repeated for Figure 3a.

INSTRUCTIO	N SENTENCE
(11) a.	Dikse mu tin ikona pu dixni show.2SG.IMP me the picture that show.3SG
	'Show me the picture that shows'
INDICATIVE	EMBEDDED CLAUSE
b.	oti kapios zografise enan pinaka. that someone painted.3SG a painting
RELATIVE EN	ABEDDED CLAUSE
с.	kapion pu zografise enan pinaka.
	someone that painted.3SG a painting

It should be noted that, in this environment as well, the sentence in (11c) can be the referent of a neuter pronoun, (12); hence the sentence describes a situation, and so the event reading is accessible to the hearer. In other words, (11c) can be paraphrased as *show me the picture describing the result situation that contains someone and a painting.*⁵

(12)	Afto _i pu	dixni	i	ikona	ine	[kapion	ри	zografise	enan	pinaka] _i .
	this that	shows	the	picture	is	someone	that	painted	а	painting
	'What the	e picture	e sho	ows is s	ome	one paint	ing a	painting.	,	

The task of the participants was to point to the open picture of the three-picture set that they thought matched sentences (11b) or (11c). If they thought the open picture did not match the sentence they heard, they were instructed to open the third (hidden) picture, which had the opposite value for source of evidence than the nonfiller open picture. Hence Figure 2a was presented with both clause types, indicative and relative. The open picture, depicting indirect evidence, was an option for indicatives but not for relative embedded sentences; hence participants had to uncover the hidden picture in the case of relatives. With indicative sentential complements participants could, but did not have to, uncover the third picture. Figure 3a was

⁵The fact that the embedded sentence does not have to show an individual is demonstrated by the availability of grammatical sentences such as the following one:

⁽i) Dikse mu tin ikona pu dihni ton aera pu kserizose ena dendro.

show me the picture that shows the wind that uprooted a tree.







Figure 2. Indirect evidence picture set. Indicatives: Open, Filler, Hidden. Relatives: Open, Filler, Hidden.

also presented with both sentence types. The open picture, which depicts direct evidence, was an option for both the indicative and the relative embedded sentences that participants heard. For relatives, on the other hand, the open picture was the only option; hence they should uncover the hidden picture in this case. Target pictures are in bold in the captions.

There were six scenarios, around which the nonfiller pictures revolved. For each scenario we constructed two three-picture sets. For the scenario of "picture painting," for instance, the two three-picture sets correspond to Figures 2 and 3. In Figure 2a and Figure 3a the third picture is covered; in Figure 2b and Figure 3b it is open. The nonfiller pictures in Figure 2a and Figure 3a are the upper left ones and differ in terms of source of evidence, direct (i.e., someone painting the picture, in Figure 3a) versus indirect (i.e., the picture being painted, in Figure 2a). For each of the three-picture sets participants heard the same two sentences, an indicative, (11b), and a relative, (11c). This means that they heard four sentences for each scenario, and given that there were six scenarios, they heard 24 sentences in total. The four sentences of each scenario were presented in blocks, and the order of sentences within each block was pseudo-randomized.

a.







Figure 3. Direct evidence picture set. Indicatives: Open, Filler, Hidden. Relatives: Open, Filler, Hidden.

The filler picture was not always in the same position with respect to the experimental open picture in Figure 2a and Figure 2b. The pictures were the same as those used in the comprehension experiment of Winans et al. (2015) but were administered in a different manner—not as the felicity judgment picture task Winans et al. employed, but in the manner just described. All scenarios and conditions appear in Appendix A.

Notice that, following suggestions in Winans et al. (2015), instructions were given to the participants via the imperative form of the verb, *dikse mu* 'show me,' to avoid confounds such as experimenter's authority and to make sure participants use their own mental perspective about what they perceive. Moreover, no puppet was used; hence "puppet's authority" did not interfere either. Recall also that the fact that the verb under which indicative and relative sentences were embedded was *show*, rather than a mainstream perception verb, permitted to not have an

a.

individual as the subject of this sentence, as participants could potentially then take this individual's mental state or source of evidence into consideration as well, with the consequences argued for in Ünal & Papafragou (2016) and (2020).⁶

4.3. Data preparation and analysis

Data were prepared for statistical analysis in R (R Core Team 2021) using core functions and the packages openxlsx (Schauberger & Walker 2021), data.table (Dowle & Srinivasan 2021), and tidyverse (Wickham et al. 2019). The participants' accuracy (target answer when pointing to the appropriate picture, nontarget answer when pointing to another picture) was automatically calculated as target (1) or nontarget (0). Moreover, opening the hidden picture was coded as 1 in the Relative Indirect condition, (10b). Opening the hidden picture was coded as 0 in all other conditions, however, since the experimental picture in the three-picture set that participants saw matched the sentences they heard. However, opening the hidden picture in the Indicative conditions, (10a) and (10c), was in fact preference rather than nontarget answer, a behavior to be discussed in the Discussion section.

For the total of the 2,080 observations analyzed, we used the lme4 package (Bates et al. 2015), and we fitted a generalized linear mixed effects model with binomial distribution and logit link function (estimated using ML and BOBYQA optimizer) to predict accuracy (dependent variable) using the main fixed effects of Group (second grade vs. third grade vs. fourth grade vs. fifth grade vs. adults) and Condition (Indicative-Indirect vs. Relative-Indirect vs. Indicative-Direct vs. Relative-Direct) and their interaction term. Random intercepts were included for participant and item (i.e., each triad of pictures). Additionally, because a significant interaction was found, we followed up with a series of pairwise tests on the estimated marginal means between the combinations of Groups and Conditions, using the emmeans package (Lenth 2021). In the pairwise comparisons, *p* values were adjusted by the Tukey's method.

5. Results

The results do not include the answers to the first two blocks of sentences (see Appendix A), as we decided to exclude them due to the fact that adult performance was at chance level on the Relative-Indirect Condition contained in them. Therefore, we are analysing 2,080 answers (out of the 3,120), which amount to 130 individuals x 4 blocks of sentences x 4 conditions in each block.⁷ The results showed that overall, adults differed significantly from all other groups. Moreover, there was a significant difference between Condition Relative-Indirect and Conditions Indicative-Indirect and Indicative-Direct. For details of the model's results see Appendix B.

We will look at the results more closely. Figure 4 depicts the development of the estimated marginal mean success probability (accuracy) for each condition, ordered from the youngest group (second grade) to the oldest (adults).

Table 4 demonstrates the estimated marginal means (probability of getting a correct answer) with SE (Standard Error) and confidence intervals (95% CI) for each Group and Condition.

Pairwise comparisons uncovered differences between Groups in the four Conditions (Comparison 1) and differences within Groups between Conditions (Comparison 2). Table 5 includes the significant results of the two comparisons.

⁶It should be noted that in the beginning we ran the task as a two-picture choice task to a limited number of adults. Because we found that some of them did not give target response on the Relative-Indirect Condition, we developed the version of the experiment we have presented here. Our idea was that if we made the task more involving, which we believe we attained by adding a hidden picture that could be uncovered, participants would be more focused.

⁷The suggestion of a reviewer played an important role in this decision. Based on the observation in a previous version of the paper that adults had an unexpectedly high error rate on the Relative-Indirect Condition (17%), and that the overwhelming majority of these errors were clustered in the first two blocks of sentences, the reviewer suggested that we recalculate the results without the first two blocks (hence, we analyzed four rather than six blocks of sentences). In this process we found that adults actually performed at chance in the first two instances of the Relative-Indirect Condition.



Figure 4. Accuracy by conditions over groups (estimated marginal means).

Condition		2nd grade	3rd grade	4th grade	5th grade	Adults
(i) Indicative Ir	direct					
Probability		0.77	0.66	0.68	0.69	0.72
SE		0.05	0.06	0.06	0.06	0.05
95% CI	Upper	0.91	0.84	0.86	0.86	0.87
	Lower	0.53	0.41	0.43	0.44	0.48
(ii) Relative Inc	lirect					
Probability		0.27	0.56	0.81	0.84	0.97
SE		0.06	0.07	0.05	0.04	0.02
95% CI	Upper	0.52	0.78	0.93	0.95	1.00
	Lower	0.11	0.32	0.58	0.62	0.82
(iii) Indicative	Direct					
Probability		0.93	0.76	0.60	0.55	0.56
SE		0.03	0.05	0.07	0.07	0.06
95% CI	Upper	0.99	0.90	0.81	0.77	0.77
	Lower	0.75	0.52	0.36	0.31	0.33
(iv) Relative Di	rect					
Probability		0.98	0.90	0.92	0.95	0.97
SE		0.01	0.03	0.03	0.02	0.02
95% CI	Upper	1.00	0.97	0.98	0.99	1.00
	Lower	0.79	0.69	0.72	0.76	0.82

Table 4. Estimated marginal means of the accuracy for each Condition and Group.

Comparison 1 deals with differences between groups for each Condition separately. In Condition Relative-Indirect, the second grade differed significantly from the third grade (p = 0.016), the fourth and fifth grades, as well as from the adults (p < .001). The third grade differed significantly from the second grade (p = .016) and also the fifth grade (p = .010) and the adults (p < .001). In Condition Indicative-Direct the second grade differed significantly from the fourth grade (p = .002) and fifth grade (p < .001) as well from the adults (p < .001). All other groups of

Comparison 1 (each condition between groups)							
Condition	Group1 vs. Group2		Odds ratio	z ratio	p value		
(ii) Relative Indirect	2nd grade	3rd grade	0.286	-3.866	.0162		
		4th grade	0.086	-6.853	<.0001		
		5th grade	0.070	-7.191	<.0001		
		Adults	87.906	-7.893	<.0001		
	3rd grade	5th grade	0.243	-3.984	.010		
		Adults	25.151	-5.797	<.0001		
(iii) Indicative-Direct	(iii) Indicative-Direct 2nd grade		9.380	4.915	.0002		
		5th grade	11.618	5.400	<.0001		
		adults	0.089	5.423	<.0001		
Comparison 2 (conditions	within each group)					
Group	Group Indicative vs. Relative		Odds ratio	z ratio	p value		
2nd grade	Indirect (i vs. ii)	0.111	5.431	<.0001		
Adults			12.780	-4.283	.0030		
4th grade	Direct (iii vs iv)		0.138	-4.215	.0040		
5th grade			0.071	-5.048	.0001		
Adults			0.040	-5.488	<.0001		

Table 5. Summary of pairwise comparisons.

children did not differ from each other and from the adult group. In the other Conditions— Condition Indicative-Indirect and Condition Relative-Direct—there was no significant difference between groups.

Comparison 2 deals with differences between Conditions for each group separately. For Conditions Indicative-Indirect and Relative-Indirect, which map indirect evidence across sentence types, a significant difference was observed for second grade (p < .001) and adults only (p = .003). For Conditions Indicative-Direct and Relative-Direct, which map direct evidence across sentence types, a significant difference was found for fourth grade (p = .004), fifth grade (p = .001) and adults (p < .001) and adults (p < .001).

5.1. A potential confound rejected

A first and clear finding from Table 4 and the statistical analysis in the previous section is that younger children accepted to a large extent Relative sentences with Indirect evidence. This is definitely the case with the second-graders, who had a 27% target performance only, and one could say the same even for third-graders, who performed around chance on a condition that is unacceptable by adults. Because of the nature of the task, which requires uncovering the hidden picture in search of target mapping of source of evidence, it was reasonable to think that younger children have trouble uncovering the picture for reasons unrelated to the study.

To exclude this possibility, we created a short task of exactly the same type to assess a different domain—spatial relations such as *inside*, *outside*, *behind*, *in front*, *under*, etc. These are known to have been mastered by children of the age groups in this study (see Terzi & Tsakali 2009; Terzi, Tsakali & Zafeiri 2015, and references therein); hence if children still did not open the hidden picture, it would mean that the task is not appropriate for their age. Figure 5 shows a representative three-picture set assessing *in front*. Children were given the set of pictures on the left, were asked to tell whether "the cat was in front of the box" in any of the open pictures, and if not, to uncover the third one. The set on the right shows what children saw after they opened the hidden picture.

The task was administered to second-grade children, and because the result was ceiling performance, we did not see the need to administer it to the third-graders. We concluded, therefore, that the low and around chance performance that second- and third-graders respectively manifest on indirect evidence associated with embedded relative sentences was not a task



Figure 5. Assessment of locative terms via the same type of experiment.

effect. Instead, younger children do not know what to do with indirect evidence and embedded relative sentences, in clear contrast with older children and adults, who, by and large, do not accept this mapping and uncover the third picture in search for a felicitous one.

6. Discussion

The main purpose of this study was to investigate when and how Greek-speaking children comprehend mapping source of evidence associated with an utterance onto a specific syntactic structure once certain difficulties that are held responsible for the late comprehension of evidentiality, considered to account for the production-comprehension asymmetry in acquiring evidentiality, are controlled for. In undertaking this investigation, we were intrigued by the fact that the most recent study on syntactically encoded evidentiality, Winans et al. (2015), did not find mastery of the related comprehension tasks in English up until (even) older ages than the ones at which production of the same structures was first attested in spontaneous speech.

We start the discussion with row (i) of Table 4, Condition Indicative-Indirect. This row reports the findings on the condition in which participants see sets of three pictures where the open one provides indirect evidence while they hear an indicative embedded sentence. Since indicative sentences are compatible with indirect evidence, participants do not have to open the hidden picture, although it would be licit to do so. Children of the youngest groups do not open the third picture much and do not differ significantly in this respect, neither from the other children's groups nor from adults. This by itself does not necessarily tell us much about children, however, as it will emerge from the following conditions.

The most crucial evidence on when children approach adult behavior in mapping source of evidence to sentential type comes from row (ii), Condition Relative-Indirect. This reports on the condition in which the related open picture, which provides indirect evidence again, is mapped to a relative embedded sentence, but this mapping is illicit in the adult grammar. Hence when faced with this condition, participants should opt for the hidden picture in search of direct (target) evidence, which they have to uncover. Yet children of the youngest group, whose performance differs significantly from that of all other groups, opened the third picture at a very low rate—27%. This is not because they are reluctant to open the hidden picture, as we confirmed by the task reported in section 5.1. Rather, younger children are most likely not aware of the ban on this mapping. Starting from third grade, which is at age 8 (see Table 3), children are not satisfied with the open picture at much higher rates, as indicated by the fact that they differ significantly from second grade, yet they perform around

chance in uncovering the hidden picture (56%). Moreover, they also differ from fifth grade and adults on this condition. At fourth grade, however, which is at age 9, children diverge drastically and are not satisfied with the open picture for this condition anymore at a much higher rate; they open the hidden picture in search of direct evidence and differ significantly from the first group (second grade) in this respect. Moreover, starting from fourth grade, children do not differ significantly from adults anymore. But note that fourth-grade children do not differ from third-grade children either, who, however, differ from adults. This suggests to us that third grade constitutes a transitional period between nonadult and adult mapping of source of evidence. We consider this an important finding, demonstrating that it is only at fourth grade—that is at age of 9—or after that Greek-speaking children start to behave like adults in that they do not map indirect evidence to relative sentential complements anymore. Recall that the comprehension study of Winans et al. (2015) was not able to detect knowledge of children's mapping source of evidence to a particular syntactic structure, but their study investigated children up to age 6, an age at which Greek-speaking children would not demonstrate adult mapping either.

It should be noted that although children do not differ significantly from adults after fourth grade, they still perform at lower rates compared to them (although no lower than 80%). On the other hand, adults have almost ceiling performance on Condition Relative-Indirect. A consequence of this is that there is a difference between the two conditions of Indirect evidence for adults but not for children, as we will see soon.⁸ Yet, there is further supporting evidence that around fourth-grade children map source of evidence to sentence type in an adult manner, and that third grade is a transitional period. It comes from mapping direct evidence to sentence type, explained in the following.

The last two rows of Table 4 report answers on Direct source of evidence for each clause type. We know for Condition Indicative-Direct, row (iii) in the table, that direct evidence is a valid choice for the relevant open picture and that participants do not have to open the hidden picture. They indeed do not do so up to a rate of about 56%. This reveals a rather peculiar pattern that adults display, however: Although one would expect them to be satisfied with the direct evidence provided in the open pictures in this condition—hence not uncover the hidden picture—they still uncover it at a considerable rate—at the remaining 44%. We take this to mean that adults have a "preference" for indicatives and indirect evidence, despite the fact that both sources of evidence may be mapped to indicatives. Children do not start out like this; instead, they approach adult behavior in this respect at fourth and fifth grades, when they do not differ from adults anymore (but differ from the youngest group). Third-graders, on the other hand, while not differing significantly from adults on this condition, they do not differ from the younger children either. Thus, we see that children's performance in terms of developing a "preference" for associating indicative sentential complements with indirect evidence begins pretty much at the same age they begin to pattern with adults in terms of knowing that indirect evidence is not compatible with relative sentential complements.

Finally, row (iv) reports on Condition Relative-Direct—on embedded relative sentences matched with direct evidence—which is the target choice for participants and the only target choice for this clause type. Adults seem to know this well; hence they map direct evidence to embedded relatives at a rate of about 97% and do not open the hidden picture. Children appear to display similar behavior in that they do not differ significantly from adults throughout groups. This does not mean that children pattern adult behavior from earliest grades, however. Rather, second-grade children do not attempt to open the hidden picture because they have not figured out yet which source of evidence can be mapped to relative clauses, as we concluded in the discussion of Condition Relative-Indirect. At third grade—at age 8—most probably children still do not know clearly, as concluded in the discussion of Condition Relative-Indirect, but they are in a transitional stage of figuring out. At fourth grade, when we know from Condition Relative-Indirect that children map indirect evidence in an adult manner, their

⁸To be precise, second-graders also differ between Condition Indicative-Indirect and Condition Relative-Indirect but for the opposite reasons—because of their very low performance on Condition Relative-Indirect.

performance on direct evidence and embedded relative sentences approaches even more that of adults. Finally, the difference between the two conditions, Indicative-Direct and Relative-Direct, which is significant in the adult group, becomes significant for the fourth- and fifth-graders. Taken together, the results from the previous two conditions demonstrate that children's performance on Direct evidence starts to resemble that of adults at fourth grade—at age 9— which is also the age at which they pattern with adults in mapping indirect evidence to sentence type.

Before concluding, we will return briefly to Condition Relative-Indirect, which maps indirect evidence to embedded relative sentences and is illicit in the adult grammar. As reported in the Results section, we noticed in the first calculation of the results an unusually high error rate of adults-adults did not open the hidden picture in search of direct evidence at a rate of 17%, with most errors committed in the first two blocks of sentences.⁹ Following a reviewer's suggestion, we recalculated the results after having excluded the responses to the first two blocks, and these are the results reported in Table 4. We found out that the adult error rate dropped dramatically, from 17% to 3%, resulting in the 97% target performance of Table 4. It should be noted that the errors came from only 13 out of the 30 adults; hence it is unlikely that there is a general strategy that is being developed. We are not entirely sure as to what this switch to target behavior is due to, although we tend to believe that it is because it took some time for some individuals to focus on the experiment.¹⁰ Notice that children's performance improved as well but somehow less drastically. Hence fifth-grade target performance improved from 75% to 84%, fourth-grade from 73% to 81%, third-grade from 45% to 56%. It is interesting that the second-grade group improved from 24% to only 27%, which we take to mean once more that younger children have not yet figured out how to map source of evidence to sentential type; hence no issue of focusing on the experiment arises for them, which can be eliminated by eliminating the first two blocks of sentences. As a last confirmation of our findings in terms of the age at which the relevant structures are mastered by Greek-speaking children, it is important to point out that the comparisons between children and adults did not change in the new calculation of the resultsafter we excluded the first two blocks of sentences/scenarios (with minor differences concerning that the third-grade group).

A reviewer asked whether the peculiar behavior of adults on Condition Indicative-Direct, row (iii) of Table 4, where adults open the hidden picture, opting for indirect evidence for indicatives, also changes after the first two blocks of sentences. We do not have serious evidence for such a pattern, as searching for indirect evidence in indicatives increased from 42% to only 44% in adults (hence their 56% target performance in Table 4).¹¹ We attest therefore a different pattern on these two conditions in terms of the role that the first two blocks of sentences played.¹²

⁹It is interesting to point out here that the adults in the study of Winans et al. (2015) had a similar performance, erroneously accepting raised sentences with indirect evidence at a rate of 23%.

¹⁰A reviewer asked what exactly the first two blocks of sentences contained. They contained the conditions associated with the first two scenarios—the "picture painting" and the "cube playing" scenarios of Appendix A. One could think that the problems with the first two scenarios did not stem from the fact that participants had not focused on the experiment from the very beginning, as we have suggested, but that there was something wrong with the first two scenarios and/or with the corresponding pictures. Apart from the fact that we could not detect any such pitfalls, we believe this cannot be the case because only 13 out of the 30 adults demonstrated such behavior.

¹¹For children there was hardly any change in terms of preference for indicatives and indirect evidence—fifth grade changes from 43.33% to 45%, fourth grade from 40.67% to 40%, third Grade from 28.67% to 24%, and second grade from 7.33% to 7%.

¹²Following a reviewer's suggestion, we conducted an informal survey testing the acceptability of relative and indicative embedded sentences with adults by using different indirect/direct auditory scenarios, along the lines of Rett & Hyams (2014); see Appendix C. We administered the protocol to 10 adults, other than those who participated in the study, and the results are consistent with the adult results on the structured experiment reported in Table 4 in interesting ways: Most relevant, participants did not accept Relative-Indirect mapping, although the rating they gave was either 0 or 1 in a scale of 5. On the other hand, we noticed two profiles for direct evidence scenarios: Some participants gave equal chances to Indicative-Direct and Relative-Direct, rating them with 4 or 5; others rated Indicative-Direct lower, i.e., with 2 or 3, and Relative-Direct with 5.

6.1. The production-comprehension asymmetry revisited

Recall that apart from discovering the age at which Greek-speaking children pattern with adults in mapping source of evidence to sentence type, we are also interested in evaluating the view according to which the production-comprehension asymmetry is due to a specific factor—perspective taking. This view is entertained in Ünal & Papafragou (2016), where it is argued that

[...] Turkish learners' difficulties with the comprehension of evidential morphology is tied to the perspectivetaking demands of considering other cognizers' access to information. This conclusion coheres with prior developmental studies showing that linguistic knowledge of evidentiality builds on and closely follows conceptual knowledge about sources of information, and suggests an even tighter and more specific relation between linguistic knowledge of an evidential system and children's developing abilities to handle various information sources compared to those prior reports (Ozturk & Papafragou 2016, Papafragou et al. 2007).

Similarly, Unal & Papafragou (2020:122) argue that the production-comprehension asymmetry stems

[...] from the development of perspective-taking abilities needed to compute others' informational sources and resulting mental states: producing evidentially marked utterances involves accessing and reporting one's own information sources, whereas understanding evidentially marked utterances involves reasoning about someone else's (i.e. the speaker's) information sources.

Since in our study we made a special effort to exclude the interference of others' perspective but we found that comprehension is delayed until the age of 9, we conclude that there cannot be a single factor —others' perspective-taking—or the similar factors suggested by Winans et al. (2015) that are responsible for the production-comprehension asymmetry or, more precisely, for the delayed comprehension the current study also found.

What can be possibly going on? Note that Ünal & Papafragou (2020) also point out "[...] conceptual factors may not be sufficient in explaining the delay in the acquisition of mental terms" but "Other factors may also complicate the mapping process (e.g., the fact that evidentials, as in the case of the Turkish system, sometimes encode multiple meanings)." We would like to argue that these other factors are purely linguistic in the cases at hand. In particular, both the linguistic means onto which evidentiality is mapped and the manner in which mapping occurs play an important interfering role. Concretely, we believe that syntactically encoded evidentiality, in the manner manifested in the English studies that motivated ours but also in the current study, bear important differences from the morphologically encoded evidentiality of the Turkish or Korean type or of the other languages reported in the Introduction section. We see in examples (1) and (2) that the evidentiality marker is present in matrix clauses in Tariana and Quechua, and the same holds for Turkish and Korean (see, for instance, Ozturk & Papafragou 2016; Papafragou et al. 2007). In English and Greek, on the other hand, the relevant structures are always biclausal. Furthermore, as also demonstrated in (1) and (2), various types of verbs, and even nouns, may bear an evidentiality marker, and similar considerations hold for Turkish and Korean verbs. Only certain embedding verbs map source of evidence in English or Greek on the other hand. Finally, one of the relevant structures, indicative in Greek and unraised seems like in English, may express either source of evidence.¹³ This is not the case with evidentiality markers, to our knowledge. It seems to us, in other words, that Rett & Hyams (2014) and Winans et al. (2015) have underestimated the importance of grammatical factors in complicating children's acquisition of syntactically encoded evidentiality, although they do mention the optionality of English evidential mapping (see our footnote 3). Rett & Hyams (2014) and Winans et al. (2015), on the other hand, draw attention to the fact that evidential morphemes suffer the drawback of expressing more than source of evidence at the same time, e.g., aspect. But how sure are we that this factor poses a serious difficulty, given that there is no conceivable confusion of aspect with source of evidence? A Greek indicative, on the other hand, which is compatible with both indirect and direct evidence, has more chances of inducing a complication in the

¹³Interestingly, the reasons why one of these structures, the indicative, may be associated with indirect evidence have not been nailed down by semantic theory, as Moulton & Grillo (2015) point out.

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relevant sense. Therefore, we conclude that syntactically encoded evidentiality, at least as manifested in the languages investigated so far—Greek and English—poses additional (grammatical) obstacles to children—hence their late mastery of comprehension experiments.

But if late comprehension of syntactically encoded evidentiality is also due to the grammatical structures involved and the manner in which they interact with source of evidence, how are the early production and the production-comprehension asymmetry explained? An alternative way to ask is whether production of syntactically encoded evidentiality is indeed attested as early as Rett & Hyams's (2014) claim. This question challenges Rett & Hyams (2014), but we think it is for good reasons. Notice that as Rett & Hyams point out, the raised version of PVSs in (4b), repeated in the following, can only express direct evidence.

(4b) John seems/looks/sounds like he won the race.

As an anonymous reviewer points out to us, however, associating subject raising with direct evidence situations in English might be driven by reasons other than children's having mastered mapping of raised PVSs to direct evidence. For instance, an agent who was witnessed to do something is likely to be more salient in the mind of the viewer than one whose action was not witnessed. When an agent is cognitively salient while the speaker/viewer is speech planning, its lexeme might be more primed and thus more likely inserted into the subject slot, as in (4b). Rett & Hyams may argue against this idea because they found four instances of standard raising sentences, such as in (12), in children's corpora that express indirect evidence, despite the fact that the agent is in the subject position of the raising verb (see Table 2). Given that this mapping is licit for standard raised *seem*, it provides a good piece of evidence that children differentiate between *seems* and *seems like* in terms of mapping source of evidence.¹⁴

(12) John seems to have won the race.

Note, however, that by contrast to the instances with PVSs, (4), which Rett & Hyams (2014) analyze in detail per age and source of evidence in their Table 5, they do not show at which age these four instances of standard *seem* with indirect source of evidence are found. If they were only found after the age of 6, it is entirely possible that until that age children use the strategy mentioned previously hence the conclusion that they have acquired mapping source of evidence to grammatical structure early is seriously weakened. If this is indeed the case, both production and comprehension of mapping source of evidence to a particular syntactic structure is delayed, with the lag between them to be determined, while acquiring syntactically encoded evidentiality in the overall may be more delayed than when evidentiality is encoded morphlogically.

7. Conclusion

We have reported in this article the results of a comprehension study on how and when source of evidence is encoded in the syntax of Greek-speaking children. The study took into consideration a number of factors that, according to Winans et al. (2015), may have been responsible for the late comprehension of syntactically encoded evidentiality in the English study they conducted. Some of these factors—notably, others' source of evidence or mental perspective—have been held responsible for late comprehension of evidentiality, hence also the production-comprehension asymmetry in acquiring evidentiality by Ünal & Papafragou (2016). Although the study reported here is clean of the pitfalls pointed out by the previous researchers, Greek-speaking children did not appear to comprehend mapping of source of evidence to clause type before age 9. This leads us to propose

¹⁴It should be noted that our survey in the Greek part of CHILDES for comparable production data did not give any results, presumably because of the small number (6) and the very young age (1;07 to 2;11) of children in the database.

that there are indeed additional factors complicating children's task in mastering evidentiality, as is in fact suggested by Ünal & Papafragou (2020). Concretely, we argue that syntactically encoded evidentiality, at least as manifested in the languages studied so far—English and Greek—is structurally a more complex phenomenon, when compared to expressing source of evidence morphologically, and we have argued for specific factors that contribute to the complexity. As a result, what we consider an important contribution of our article is that the late comprehension of syntactically encoded evidentiality, and perhaps late acquisition of syntactically encoded evidentiality overall, should not be a surprise. Nevertheless, it is only after a detailed production study is carried out, ideally in both languages, that the picture can be considered complete.

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Appendix A: Scenarios and conditions

1. Picture-painting Scenario

- a. *Dikse mu tin ikona pu dixni oti kapios zografise enan pinaka.* show me the picture that shows that someone painted a painting 'Show me the picture that shows that someone painted a painting.' [*Indicative-Indirect* source of evidence in open picture, (10a)]
- b. Dikse mu tin ikona pu dixni kapion pu zografise enan pinaka. show me the picture that shows someone that painted a painting 'Show me the picture that shows someone that painted a painting.' [Relative-Indirect source of evidence in open picture, (10b)]
- c. Dikse mu tin ikona pu dixni oti kapios zografise enan pinaka. show me the picture that shows that someone painted a painting 'Show me the picture that shows that someone painted a painting.' [Indicative-Direct source of evidence in open picture, (10c)]
- d. *Dikse mu tin ikona pu dixni kapion pu zografise enan pinaka.* show me the picture that shows someone that painted a painting 'Show me the picture that shows someone that painted a painting.' [*Relative-Direct* source of evidence in open picture, (10d)]

2. Cube playing scenario

- a. Dikse mu tin ikona pu dixni oti kapios epekse me tus kivus. show me the picture that shows that someone played with the cubes 'Show me the picture that shows that someone played with the cubes.' [Indicative-Indirect source of evidence in open picture, (10a)]
- b. *Dikse mu tin ikona pu dixni kapion pu epekse me tus kivus.* show me the picture that shows someone that played with the cubes 'Show me the picture that shows someone that played with the cubes.' [*Relative-Indirect* source of evidence in open picture, (10b)]
- c. Dikse mu tin ikona pu dixni oti kapios epekse me tus kivus. show me the picture that shows that someone played with the cubes 'Show me the picture that shows that someone played with the cubes.' [Indicative-Direct source of evidence in open picture, (10c)]
- d. *Dikse mu tin ikona pu dixni kapion pu epekse me tus kivus.* show me the picture that shows someone that played with the cubes 'Show me the picture that shows someone that played with the cubes.' [*Relative-Direct* source of evidence in open picture, (10d)]

3. Toy train breaking scenario

- a. Dikse mu tin ikona pu dixni oti kapios espase to trenaki tu. show me the picture that shows that someone broke the toy train his 'Show me the picture that shows that someone broke his toy train.' [Indicative-Indirect source of evidence in open picture, (10a)]
- b. *Dikse mu tin ikona pu dixni kapion pu espase to trenaki tu.* show me the picture that shows someone that broke the toy train his 'Show me the picture that shows someone that broke his toy train.' [*Relative-Indirect* source of evidence in open picture, (10b)]
- c. *Dikse mu tin ikona pu dixni oti kapios espase to trenaki tu.* show me the picture that shows that someone broke the toy train his 'Show me the picture that shows that someone broke his toy train.' [*Indicative-Direct* source of evidence in open picture, (10c)]
- d. *Dikse mu tin ikona pu dixni kapion pu espase to trenaki tu.* show me the picture that shows someone that broke the toy train his 'Show me the picture that shows someone that broke his toy train.' [*Relative-Direct* source of evidence in open picture, (10d)]

4. Breakfast Scenario

- a. *Dikse mu tin ikona pu dixni oti kapios eftiakse proino.* show me the picture that shows that someone made breakfast 'Show me the picture that shows that someone made breakfast.' [*Indicative-Indirect* source of evidence in open picture, (10a)]
- b. *Dikse mu tin ikona pu dixni kapion pu eftiakse proino.* show me the picture that shows someone that made breakfast 'Show me the picture that shows someone that made breakfast.' [*Relative-Indirect* source of evidence in open picture, (10b)]
- c. *Dikse mu tin ikona pu dixni oti kapios eftiakse proino.* show me the picture that shows that someone made breakfast 'Show me the picture that shows that someone made breakfast.' [*Indicative-Direct* source of evidence in open picture, (10c)]
- d. *Dikse mu tin ikona pu dixni kapion pu eftiakse proiono.* show me the picture that shows someone that made breakfast 'Show me the picture that shows someone that made breakfast.' [*Relative-Direct* source of evidence in open picture, (10d)]
 5. Mud scenario
- a. Dikse mu tin ikona pu dixni oti kapios efere laspi show me the picture that shows that someone brought mud sto dhomatio.
 in-the room
 'Show me the picture that shows that someone brought mud in the room.'

[Indicative-Indirect source of evidence in open picture, (10a)]

b. *Dikse mu tin ikona pu dixni kapion pu efere laspi* show me the picture that shows someone that brought mud sto dhomatio. in-the room

'Show me the picture that shows someone that brought mud in the room.' [*Relative-Indirect* source of evidence in open picture, (10b)]

c. *Dikse mu tin ikona pu dixni oti kapios efere laspi* show me the picture that shows that someone brought mud sto dhomatio. in-the room

'Show me the picture that shows that someone brought mud in the room.' [*Indicative-Direct* source of evidence in open picture, (10c)]

d. *Dikse mu tin ikona pu dixni kapion pu efere laspi* show me the picture that shows someone that brought mud sto dhomatio. in-the room

'Show me the picture that shows someone that brought mud in the room.' [*Relative-Direct* source of evidence in open picture, (10d)] **6. Prize scenario**

- a. Dikse mu tin ikona pu dixni oti kapios kerdhise ena vravio. show me the picture that shows that someone won a prize 'Show me the picture that shows that someone won a prize.' [Indicative-Indirect source of evidence in open picture, (10a)]
- b. *Dikse mu tin ikona pu dixni kapion pu kerdhise ena vravio.* show me the picture that shows someone that won a prize 'Show me the picture that shows someone that won a prize.' [*Relative-Indirect* source of evidence in open picture, (10b)]
- c. *Dikse mu tin ikona pu dixni oti kapios kerdhise ena vravio.* show me the picture that shows that someone won a prize 'Show me the picture that shows that someone won a prize.' [*Indicative-Direct* source of evidence in open picture, (10c)]
- d. *Dikse mu tin ikona pu dixni kapion pu kerdhise ena vravio.* show me the picture that shows someone that won a prize 'Show me the picture that shows someone that won a prize.' [*Relative-Direct* source of evidence in open picture, (10d)]

Appendix B: Logistic mixed effects model results

The model [*accuracy* ~ *Group* * *Condition* + (1 | *item*) + (1 | *participant*)] had AIC = 1974.99 and BIC = 2099.08. The model's total explanatory power was substantial (conditional $R^2 = 0.37$), and the part related to the fixed effects alone (marginal R^2) was of 0.32. The model's intercept, corresponding to Group = Adults and Condition = Relative-Indirect, was at 3.48 (95% CI [2.43, 4.54], *p* < .001).

		Est.	SE	Z	р
	Intercept	3.48	0.54	6.46	<.001***
Fixed effects					
Adults	2nd grade	-4.48	0.57	-7.89	<.001***
	3rd grade	-3.22	0.56	-5.80	<.001***
	4th grade	-2.02	0.57	-3.52	<.001***
	5th grade	-1.81	0.58	-3.12	<.01**
Con(ii)	Con(i)	-2.55	0.59	-4.28	<.001***
	Con(iii)	-3.23	0.59	-5.48	<.001***
	Con(iv)	-0.01	0.75	-0.01	0.99
		4.75	0.64	7.40	. 001***
Adults & Con(II)	2nd grade & Con(I)	4.75	0.64	7.40	<.001***
	Srd grade & Con(I)	2.94	0.62	4./2	<.001***
	4th grade & Con(i)	1.83	0.64	2.86	<.01**
	5th grade & Con(i)	1.67	0.65	2.58	0.01*
	2nd grade & Con(iii)	6.89	0.71	9.69	<.001***
	3rd grade & Con(iii)	4.12	0.63	6.58	<.001***
	4th grade & Con(iii)	2.20	0.63	3.48	<.001***
	5th grade & Con(iii)	1.78	0.64	2.78	0.01*
	2nd grade & Con(iv)	5.00	1.03	4.84	<.001***
	3rd grade & Con(iv)	1.93	0.81	2.83	0.02*
	4th grade & Con(iv)	0.95	0.83	1.15	0.25
	5th grade & Con(iv)	1.19	0.87	1.37	0.17
Random effects		Variance		SD	
Participant		0.12		0.34	
Word		0.11		0.33	

Note. Con(i) = Indicative Indirect, Con(ii) = Relative Indirect, Con(iii) = Indicative Direct and Con(iv) = Relative Direct. ***p < .001; **p < .01; *p < .05.

Appendix C: Informal survey protocol

Participants were admistered the scenarions in (1-5) orally. After each scenario, they heard either an Indicative or a Relative sentential complement of two perception verbs, *see* and *hear*. Participants were asked to judge how natural each of the two sentences sounded given the preceding scenario, on a scale from 0 (*worst*) to 5 (*best*).

1. Visual indirect

Scenario: George's mother enters his room and sees his sneakers on the floor, as well as a wet towel. She leaves the room and goes to the kitchen where George's father is watching TV. She tells him:

a. *Ida oti o Jorghos ekane banio. Indicative* saw that the George did bath

'I saw that George took a bath.'

b. *Ida ton Jorgho pu ekane banio. Relative* saw the George that did bath 'I saw George taking a bath.'

2. Visual direct

Scenario: George's mother enters the kitchen in the middle of the night and sees him eating a sandwich. She returns to the bedroom and tells his father:

a. Ida oti o Jorghos etroje ena sandwich. Indicative saw oti the George was eating a sandwich

'I saw that George was eating a sandwich.'

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b. Ida ton Jorgho pu etroje ena sandwich. Relative saw the George that was eating a sandwich 'I saw George eating a sandwich.'
3. Hearsay

Scenario: Lila heard a rumor that the mayor attended her graduation, and so she says:

- a. Akusa oti o dimarhos irthe stin orkomosia mu. Indicative
 - heard that the mayor came to-the graduation mine

'I heard that the mayor attended my graduation.'

b. *Akusa ton dimarho pu irthe stin orkomosia mu. Relative* heard the mayor that came to-the graduation mine 'I heard the mayor attending my graduation.'

4. Auditory indirect

Scenario: Maria has a next door neighbor, John, whose washing machine is very loud. She can hear it every night, and so she heard it working for an hour and half straight tonight as well.

a. Akusa oti o Janis evale plidirio ce simera. Indicative heard that the John put washing machine and today

'I heard that John did his laundry today too.'

b. *Akusa ton Jani pu evale plidirio ce simera. Relative* heard the John that put washing machine and today 'I heard John doing his laundry today too.'

5. Auditory direct

Scenario: Dora has a next door neighbor, Elena, who often calls her boyfriend in the night. Dora tonight heard Elena having an argument with her boyfriend on the telephone. Dora calls her mother upset:

- a. Akuo oti i Elena tsakonete me ton filo tis. Indicative hear that the Elena is having a fight with the friend her 'I hear that Elena is having a fight with her boyfriend.'
- b. Akuo tin Elena pu tsakonete me ton filo tis. Relative heard the Elena that is having a fight with the friend her 'I hear Elena having a fight with her boyfriend.'