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Aspect, evidentiality, and mirativity

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Abstract
In many languages, including Turkish, Bulgarian or Norwegian, present perfect morphology is ambiguous between an aspectual interpretation and the expression of indirect evidentiality, more in particular inference or hearsay (Izvorski 1997). In languages such as Washo (Hokan) or Hare (Athapaskan), morphemes that express indirect evidentiality can also be used to express mirativity (DeLancey 2001, Aikhenvald 2004, 2012). In Turkish, the present perfect can express all three semantic interpretations: present perfect (PPA), indirect evidentiality (IE), and mirativity (MIR). The question therefore arises what common element links these three interpretations and the particular pairings observed (PPA-IE, IE-MIR, PPA-IE-MIR). Previous accounts such as Bybee & Dahl (1989) and Izvorski (2007) only account for a single link in the triad: PPA-IE. We propose that a proper account of the relations between PPA, IE, and MIR requires that mirativity be redefined in terms of 'sudden discovery or realisation' (Adelaar 1977, 2012, Mexas 2016).). This redefinition allows us to explain the link between PPA, IE, and MIR in terms of the temporal nature of the traditional aspectual classes: states, processes, accomplishments, and achievements (Vendler 1967, Mourelatos 1979). Indirect evidentiality can then be viewed as the evidential counterpart of an accomplishment in the aspectual sense, while the category of mirativity should be viewed as the mirror image of achievements. We will propose a formal semantic analysis that can capture this insight and account for the specific pairings observed.

Keywords:
present perfect, aspect (indirect) evidentiality, mirativity, sudden realization, verb classes, stage, formal semantics.

1. Introduction

In languages such as Turkish, Bulgarian, or Norwegian, present perfect morphology is ambiguous between an aspectual interpretation and the expression of indirect evidentiality, more in particular inference or hearsay (Izvorski 1997). In Washo (Hokan) and Hare (Athapaskan), morphemes expressing indirect evidentiality can also express mirativity (DeLancey 2001, Aikhenvald 2004, 2012). In Turkish, the present perfect can be interpreted with all three semantic interpretations: present perfect (PPA), indirect evidentiality (IE), and mirativity (MIR). These observations raise the question what common element links these three interpretations and the three particular combinations observed (PPA-IE, IE-MIR, PPA-IE-MIR).

Previous accounts such as Bybee & Dahl (1989) and Izvorski (2007) only account for a single link in the triad: PPA-IE. We propose that a proper account of the relations between PPA, IE, and MIR requires that mirativity be redefined in terms of 'sudden discovery or realisation' (Adelaar 1977, 2012, Mexas 2016). This redefinition allows us to explain the link between the present perfect, indirect evidentiality, and mirativity in terms of the temporal nature of the traditional aspectual classes: states, processes, accomplishments, and achievements (Vendler 1967, Mourelatos 1979). We will propose that indirect evidentiality can be viewed as the evidential counterpart of an accomplishment in the aspectual sense, while the category of mirativity should be viewed as the mirror image of achievements. We propose a formal semantic analysis that accounts for this insight and account for the three observed combinations. Importantly, this semantic analysis should not be viewed as a

scenario of semantic change, but as a theoretical description of the common semantic underpinnings shared by the grammatical categories of aspect, evidentiality, and mirativity.

2. The problem

2.1. From aspect to evidentiality and mirativity

Present perfect morphology is often used as a marker of evidentiality that indicates indirect evidence for the truth of a proposition in the form of *inference* or *hearsay*. This is illustrated in (1), from Izvorski (1997:222(1)[1]):

(1) a. Turkish
Gel-mış-im.
come-PERF-1SG

b. Bulgarian
Az sam dosal.
I be-1SG.PRES come-P.PART

c. Norwegian
Jeg har kommet.
I have- SG.PRES come-P.PART
'It is said that I have come.'
'I infer that I have come'

In addition, markers of evidentiality expressing inference and hearsay are often used as miratives, expressing surprise (Jacobsen 1964, Slobin & Aksu 1982, DeLancey 1997, 2001). This can be illustrated with examples from Washo in (2)[2] and Hare in (3):

(2) Washo (Hokan ?, California, Nevada; Jacobsen 1964:630)
métu=áʔyiʔi
frozen-EVID/MIR (*our glosses added*)
'It got frozen'

(3) Hare (Athapaskan, Northwest Territories, DeLancey 2001:375-378)

a. júhye	sa	k'ínayeda	*lõ*		(= DeL 2001:(10))
hereabout	bear	SG.go.around.3SG.SUBJ.PERF	EVID		
'I see there was a bear walking around here.'					(Inference/ hearsay)
b. heee,	gúhde	daweda!	ch'ifi	dachída	*lõ* (= DeL 2001:(11))
hey,	up.there	SG.sit.3SG.IMPERF	guy	sitting	EVID
'Hey, he's sitting up there! The guy is sitting up there!'					(Mirative)

For Washo, Jacobsen (1964:630) observes that: "The prefinal suffix *-áʔyiʔ* Mirative indicates that the speaker knows of the action described by the verb, not from having observed it occur, but only inferentially from observing its effects. It thus commonly conveys an emotion of surprise."

The Turkish morpheme *-mış* cannot only express the meaning of perfect aspect (1), but also the evidential meanings of inference and hearsay (4), as well as mirativity (4):[3]

[1] The example in (1) is lifted *verbatim* with glosses and translations from Izvorski (1997).

[2] The example in (2) is lifted *verbatim* from Jacobsen (1964:630), no glosses are provided in the original.

[3] The example in (3) is lifted *verbatim* with glosses and translations from Slobin & Aksu (1982). We refer the reader to this paper for the precise conditions that facilitate each of the three interpretations.

(4) Turkish (Slobin & Aksu 1982: 187(3))
Kemal gel-mış
Kemal come-PERF
'Kemal came.'
"(a) INFERENCE: The Speaker sees Kemal's coat hanging in the front hall, but has not yet seen Kemal.
(b) HEARSAY: The Speaker has been told that Kemal has arrived, but has not yet seen Kemal.
(c) SURPRISE: The Speaker hears someone approach, opens the door, and sees Kemal—a totally unexpected visitor." (Slobin & Aksu 1982: 187)

Similar to Turkish, the perfect in Georgian can also express indirect evidentiality and mirativity (Léa Nash, p.c.). Such examples show that there is a link between three grammatical categories that appear at first sight to be unrelated: perfect aspect, indirect evidentiality (hearsay/ inference), and mirativity. Before framing the question of the relation between these three categories, we would like to critically discuss the notion of mirativity itself.

2.2. Mirativity as 'sudden realization'

Mirativity can be expressed by dedicated morphemes, and does not always depend on evidential markers of inference or hearsay. Hengeveld & Olbertz (2012) argue extensively that mirative expressions do not necessarily have an evidential component. In Magar, mirative markers can even cooccur with inferential evidentials, as in (5). This shows that the category is not always dependent on evidentiality.

(5) Magar (Tibeto-Burman, Nepal) (Aikhenvald 2012:441(2))

ŋa-i	i-din-ʌ	sya	ŋa-jya-o	le-sa-ŋ
1sg- ERG	PROX-type-ATT	meat	1.pron-eat-NMLZ	IMPF.MIR-INFER-1.pron

[I realize to my surprise that:] 'Apparently I have eaten this type of meat!'

Nevertheless, the precise semantic nature of mirativity remains somewhat elusive, leading some authors to question the very relevance of the term as a descriptor in the linguistic arsenal (Hill 2012). DeLancey (1997:34) observes that it marks a proposition as "new to the speaker, not yet integrated into his overall picture of the world". For Aikhenvald (2012:437), the label 'mirativity' can express the following viewpoints of any of the speech participants:[4] a) sudden discovery, revelation or realization b) surprise c) unprepared mind d) counterexpectation e) new information.

This discussion raises the interesting question as to which one of these meanings can be considered to be semantically more basic. Adelaar (1977, 2013) presents data from Tarma Quechua showing that miratives need not refer to either counterexpectation or surprise. In (6), the mirative *-naq* occurs in a question that lacks any expectation or counterexpectation.

[4] We use the term of speech participant here to generalize over Aikhenvald's (2012) reference to the speaker, the audience (or addressee), or the main character.

(6) Tarma Quechua (Andes)

wipi-ru-y	ma:	ayga-sh	ga-naq
weigh-PERV-2 A/S.IMP	let_us_see	how.much-REP	be-3A/S.MIR

'Weigh it, let us see how much it is!' (= Adelaar 2013:105(9))

Adelaar (1977) argues that the core meaning of this morpheme refers to 'sudden discovery', a term that has spread in the literature on Quechua since. Adelaar (2013:106) quotes additional data from Ecuadorean Highland Quichua (Olbertz 2009:70,73) supporting the idea that miratives need not express surprise. In (7), the certainty marker *-mi* indicates an objective statement devoid of surprise, and the mirative morpheme *-shka* marks realization only, translated here as 'indeed'.

(7) Ecuadorean Highland Quichua

kipi	llashak-mi	ka-shka
bundle	heavy-CERT	be-3A/S.MIR

'The bundle is heavy indeed.'

Conversely, the example in (8) shows that the non-mirative present tense can occur in an exclamative context that does express surprise:

(8) Ecuadorean Highland Quichua

ima-shina	kay	wañu-shka	kusa	manchanai-ta	miku-n-arí
what-COMPAR	this	die-NOMZ	husband	terror-ACC	eat-3A/S.PRES.-EMPH

'how terribly this dead husband is eating!'

Such facts lead Adelaar (2013:108) to suggest that the term 'mirative' may be a misnomer for Quechua, and that a more appropriate term for the interpretation of the relevant morphemes might be 'revelative'. This term is of course closely related to sudden realization or discovery. The term 'mirative' then should be interpreted as a punctual transition from the epistemic state of ignorance to that of awareness. Building on Adelaar's (1977, 2013) arguments, Mexas (2016) argues that 'sudden realization', understood as a punctual change of epistemic state, represents the semantic core meaning of mirativity. By contrast, the additional interpretations, such as 'surprise', 'unprepared mind', and 'counterexpectation' should be viewed as Gricean conversational implicatures. They constitute additional interpretations that arise in specific contexts, and are calculable, cancelable, non-detachable, and variable in the classical Gricean sense (Mexas 2016). The Quechua data provided by Adelaar (1977, 2013) and Olbertz (2009:70,73) certainly seem to bear out this idea. Mexas (2016) provides convincing arguments showing that miratives in Turkish and Ecuadorian Highland Spanish also have 'sudden realization' as their core meaning, with the additional meanings reducible to pragmatic implicatures.

In this paper, we will assume without further discussion Adelaar's (1977, 2013) and Mexas' (2016) view that the core meaning of mirativity is that of sudden realization or discovery: a punctual change of epistemic state. This redefinition of mirativity is crucial for the remainder of our analysis because it brings mirativity closer to evidentiality: both categories now can be viewed as involving a change in the epistemic state of the speech participants.

2.3. Formulating the question

How can the connection between perfect aspect, indirect evidentiality, and mirativity be accounted for? More precisely, what is the relation between the aspectual category of the present perfect, the indirect evidential meanings of inference and hearsay, and mirativity

(redefined as 'sudden realization')? It is unlikely that this connection is a matter of accidental syncretism or homonymy, since it occurs in many genetically unrelated and geographically diverse languages.[5]

One part of the question, more specifically that of the relation between present perfect and inferential and hearsay evidentials, has been addressed before in the literature. Bybee & Dahl (1989:73-74) analyse this relation in the context of grammaticalisation:

"The evidential uses of perfects develop because the perfect is used to describe past actions or events with present results. If the focus of the meaning is on the idea that the present results are connected to and perhaps attest to past actions or events, then the notion of an action known by its results can be extended to actions known by other indirect means, such as by inference (from reasoning in addition to inference from results) and by reports from other parties."

This insight is an important one, since the common denominator between perfect aspect and indirect evidentiality is identified as knowledge of an event by indirect means. Indirect knowledge of an event via its results (perfect) is extended to a wider set of indirect processes allowing for information about the event to be obtained, i.e. via inference or third party reports. The question nevertheless arises how this 'extended' meaning, including both aspectual and evidential interpretations, can be defined and represented. Bybee & Dahl's (1989) characterization of the relation between perfect aspect and indirect evidentiality remains vague about why only 'indirect knowledge' would establish such a connection between aspect and indirect evidentiality. Bybee & Dahl (1989) explain why the grammaticalisation from perfect to indirect evidential is plausible, but they do not explain why it is necessary, i.e. why precisely this shift occurs and not other, equally likely ones. Finally, Bybee & Dahl (1989) do not address the mirative use of these morphemes. Admittedly, this can be attributed to the fact that the notion of mirativity was not widely discussed in the literature until DeLancey's (1997) influential study.[6] Nevertheless, it is not immediately obvious how Bybee & Dahl's (1989) grammaticalisation path from aspect to evidentiality can be extended and adapted to include mirativity. This again raises the question of the common semantic core relating perfect aspect, indirect evidentiality, and mirativity.

Another line of thought links the relation between the present perfect and the indirect evidential to a formal semantic analysis of modality. Izvorski (1997) was the first to provide a formal analysis of the semantics of the present perfect which identified the elements that give rise to the interpretation of indirect evidentiality. Izvorski (1997) argues that the temporal interpretation of the present perfect is that the core event is excluded from the time of utterance. In addition to this temporal interpretation, the present perfect also has a modal/evidential interpretation in which the set of worlds in which *p* is known is excluded from the world of the speaker (following Kratzer's (1991) analysis for modals). In the temporal interpretation, exclusion from the time of the speaker is essential for the interpretation of the present perfect. In the modal/evidential domain, exclusion from the world of the speaker translates in the speaker having only indirect evidence for *p*. As Izvorski

[5] Izvorski (1997:236:fn1) mentions Arabic (Negev Bedouin); Albanian, Bulgarian, Icelandic, Macedonian, Norwegian, Romani, Tajik; Niger-Congo: Dogon ; South Caucasian: Georgian; Turkic: Turkish, Turkmen, and Uzbek; Uralic: Estonian , Finnish, Komi, Mari, Mansi, Nenets, Udmurt. See also Comrie (1976) and references in Nedjalkov (1988), Johanson & Utas (2000), and Aikhenvald (2004) for languages in which a relation between aspect, evidentiality, and/ or mirativity can be observed.

[6] We thank an anonymous reviewer for pointing this out to us.

(1997) puts it: "the morphology of the present perfect contributes to either the temporal interpretation of propositions (by imposing a particular ordering between time intervals), or to their evidential status (by imposing particular relations between possible worlds)." Although this is a very elegant analysis, it does not provide a solution for the relation between indirect evidentiality and mirativity/'sudden realization'. We will therefore try to pursue a different solution in the remainder of this paper.

A lot of recent work has related evidentiality to tense and aspect (see Chung 2005, 2007 and Lee 2011 for Korean; Koev 2011 for Bulgarian, Sener 2011 for Turkish). Speas (2010) and Kalsang et al. (2013) argue that evidentials denote relations between situations that are parallel to the relations between times denoted by tense and aspect. The main difference between these approaches and ours is that they compare evidentiality to grammatical aspect (imperfective/ perfective/ perfect), while we will pursue an approach that tries to establish a shared structure between lexical aspect (the Vendlerian aspectual classes) on the one hand and evidentiality and mirativity on the other. A detailed comparison between these approaches and the analysis adopted here is beyond the scope of this paper.

3. Representing the relation between aspect, evidentiality and mirativity

3.1. Aspectual classes and perfect aspect

Events are traditionally subdivided into aspectual classes: states, processes, accomplishments, and achievements. There is a large literature on this topic, which we cannot hope to do justice to here (e.g. Vendler 1967, Mourelatos 1981, Verkuyl 1972, 2005 Krifka 1987, Dowty 1979, Tenny 1994, Rothstein 2004, von Stechow 2009, Beavers 2013). We will assume that each of these classes represents a specific type of event. Although this is sometimes disputed (e.g. Walkowa 2012), we will furthermore adopt the idea that the properties of these event types can be brought out by elements interacting with the event's temporal development.

The table in (9) presents the four aspectual classes and some typical examples of each class.

(9)

Aspectual class	*Examples*
States	*resemble someone, know English, contain*
Processes	*dance, play, rain, walk*
Accomplishments	*write an article, bring a book to school, eat an apple*
Achievements	*realize something, find a solution, explode, arrive*

As discussed by Beavers (2013:681) and Rothstein (2004:6-14), these classes can be defined by two temporal properties: *telicity*, which indicates an inherent endstage to the event, and *duration*, the property of having stages in the event that lead to other stages. Telic predicates combine more easily with *in X time* modifiers, while atelic predicates combine well with for X time modifiers, as shown in (10).

(10) a. Sue resembled him for several years/?? in an hour — State: atelic
b. Sue danced for/??in an hour — Process: atelic
c. Sue wrote the article in/ ?for an hour — Accomplishment: telic
d. Sue found the solution in/ ??for an hour — Achievement: telic

Predicates involving duration, i.e. multiple stages of the same type combine easily with progressive *–ing*, while predicates that do not involve duration are less acceptable in the progressive (with some exceptions, see Rothstein 2004:36-58 for discussion).

(11) a. ??Sue was resembling her father — State: no stages
b. Sue was dancing — Process: stages
c. Sue was writing an article — Accomplishment: stages
d. ??Sue was finding the solution — Achievement: no stages

The aspectual classes can therefore be analyzed in terms of stages: stages of the same type that express duration, and endstages that represent a telic, final stage of the event. The formalization we adopt here differs from most other approaches to the decomposition of aspectual classes in that the notion of *stage* will play a key role. Most approaches to de decomposition of aspectual classes use primitive predicates such as BECOME, CAUSE, and STAY that are event-specific (see e.g. Levin & Rappaport 2011), or they directly embed arguments into the representation of event structure (e.g. Rothstein 2004).[7] By contrast, we aim at an analysis of aspectual classes whose ingredients can also be used outside of the decomposition of events, more specifically in the formal representation of evidentiality and mirativity. We assume that initial and final stages have a special ontological status, and that an initial and a final stage may or may not be related via a Process consisting of additional stages. This is represented informally in (12) as a minimal lexical template for stages, with the final stage representing a telic event or a transition.

(12)

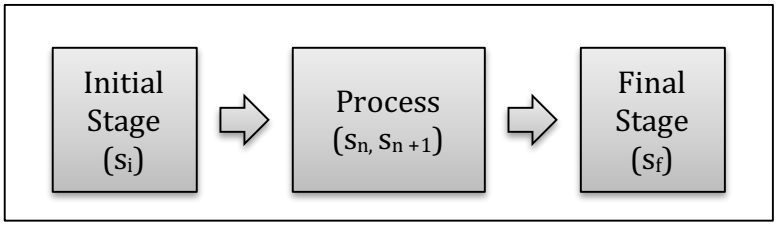

Figure 1: A minimal lexical template for stages

This model can be applied to aspectual classes, defining them in terms of strictly ordered sets of stages, as in (13):

(13)

Aspectual class	*Process*	*Telic*	*Stage types*	*Example*
States	–	–	< s >	*resemble, concern*
Processes	+	–	< s_i, s_n, s_{n+1}>	*rain, dance*
Accomplishments	+	+	< s_i, s_n, s_{n+1} , s_f >	*write, bring*
Achievements	–	+	< s_i, s_f >	*explode, arrive*

In (13), States are represented as a single stage < s >: they lack any process or telicity. Processes involve stages, but no final stage, and therefore lack telicity. We represent the set of substages of the same type that are inherent in Processes by the ordered set consisting of an initial stage (s_i) and subsequent stages (s_n, s_{n+1}), but lacking a final stage (s_f).

[7] These remarks are in no way meant as a criticism of these approaches, which are valuable in their own right. We are only trying to justify why we chose a different representation of aspectual classes than those already available in the literature.

Accomplishments consist of an initial stage (s_i), a process (s_n, s_{n+1}), and a final stage (s_f). Achievements involve an abrupt transition between an initial and a final stage. The initial stage (s_i) of processes, accomplishments and achievements refers to the stage that represents the transition from not doing something to doing something.

Morphological aspect operates on elements of these representations: inchoative morphemes highlight the initial stage, and progressive aspect emphasizes the transitions between stages of the process. Similarly, perfect aspect highlights the fact that all stages have been finalized, and that the final stage s_f holds at the time of utterance (t_{Sp}*). (e.g. Parsons 1990, Steedman 1994, Giorgi & Pianesi 1997, Izvorski 1997, Portner 2003, von Stechow 2009).

We propose to formalize this idea as in (14). Our model (M) contains an ordered set of stages or intervals *s,* represented as S; the set of events E, the precedence relation; and the time of utterance (t_{Sp}*):

(14) a. $M = << S, E, <, t_{Sp}* >>$
S = an ordered set of stages or intervals s
s = a stage or interval
< = the precedence relation
E = the set of events
e = event
t_{Sp}* = speech time

b. *Present perfect (general):*
$s = \{s \mid < s_i, ..., s_f > \subset S\}$
$\lambda s.\lambda e$ ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

The formalization of the present perfect in (14)b states on the first line that if a stage s is part of an ordered set of stages from s_i to s_f, then this ordered set will be a subset of S. The dots (...) between s_i and s_f in the ordered set indicate that additional stages may or may not be present. On the second line of (14)b, the formula states that stages that are mapped to events (the $\lambda s.\lambda e$ part) must precede the time of utterance (t_{Sp}*) and that the final stage s_f holds at t_{Sp}*. This general formulation can then be made fully explicit for accomplishments and achievements as in (15):

(15) a. *Present perfect of an accomplishment:*
$s_{acc} = \{s \mid < s_i, s_n, s_{n+1}, s_f > \subset S\}$
$\lambda s.\lambda e$ ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

b. *Present perfect of an achievement:*
$s_{ach} = \{s \mid < s_i, s_f > \subset S\}$
$\lambda s.\lambda e$ ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

Our formalization predicts that states cannot combine with the present perfect. This is so because states do not possess a *final* stage, and the formula in (14)b limits the application of the present perfect to events that have at least two stages, including a final stage. The incompatibility of states with the present perfect can be illustrated with the following sentences:

(16) a. * This inscription has been in Latin
b. John has known English since high school

In (16)a, there is a clash between a permanent property of the inscription, and the requirement of the present perfect that this property should be viewed as a stage that is finalized at utterance time. In (16)b, the present perfect can exceptionally combine with a state. This is because the adverbial clause *since high school* makes it clear that there was a time when the state of knowing English did not hold. Under the analysis presented here, this means that the adverbial clause adds an initial stage (s_i) of transition into the state of knowing English to the representation, with the state of knowing English now reinterpreted as the final stage (s_f). Since this results in a representation with more than one stage, the present perfect is licensed in accordance with the formula in (14)b.

3.2. Once again, from aspect to evidentiality and mirativity

We would now like to propose that the lexical template for stages in (12) can also be fruitfully applied to evidentiality. Note that the template is agnostic with respect to the exact nature of the stages. When applied to aspectual verb classes, these stages refer to the stages that can be distinguished in an event, but this is not the only possible interpretation for stages.

We propose that, in the case of evidentiality, the template for stages in (12) applies to information stages of the Speaker: the Speaker moves from one epistemic state to another (see also Krifka 2014). Indirect evidentiality is about the way in which information is obtained, i.e. how information stages are updated. The initial stage s_i refers to the initial information stage of the Speaker, and s_f corresponds to the Speaker's final information stage that holds at the time of utterance. The Speaker reaches the final information stage s_f via a gradual process of information updates. We propose to formalize this idea in a way that is nearly identical to that for the present perfect of an accomplishment in (14). The only relevant difference is that stages are not mapped to events but to information updates:

(17) i_u = information update

Indirect evidentiality (IE):
$s_{IE} = \{s \mid < s_i, s_j, s_k, s_l, s_f > \subset S\}$
$\lambda s.\lambda i_u$ ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

Since evidentiality always refers to the way in which the Speaker obtained the information, the relevant stage types for evidentiality must involve a final information stage s_f. As a result, the four-way typology that can be distinguished for aspectual classes reduces to two types in the case of evidentiality, corresponding to accomplishments and achievements because both of these types involve a final stage s_f.

In this context, the present perfect in languages that use it both for expressing aspectual and evidential meanings should now be more generally understood as not only referring to aspectual stages, but to both event stages and information stages. The formalization of this 'underspecified' present perfect simply lacks any reference to either events or information stages:

(18) *Present perfect/ indirect evidentiality*:
$s = \{s \mid < s_i, s_n, s_{n+1}, s_f > \subset S\}$
λs ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

As such, present perfect morphology is ideally suited for representing information state updates, because it focuses on the fact that the endpoint s_f, the final stage of both event and information stages, holds at the time of utterance.

In the remainder of this paper, we will argue that inference and hearsay evidentials correspond to accomplishments, and that mirativity/ realization corresponds to achievements. This is represented in the table in (19):

(19)

Stage types	< s >	< **s_i**, s_j, s_k, s_l >	< **s_i**, s_j, s_k, s_l , **s_f** >	< **s_i**, **s_f** >
Event stages	States	Processes	Accomplishments	Achievements
Information stages	–	–	Inference/ hearsay	Mirativity/ realization

Present perfect morphology, devoid of its strictly aspectual semantics, is used to express information update processes. Inference and hearsay can be viewed as evidentials corresponding to accomplishments: the Speaker signals that the final information stage presented in *p* was arrived at by a Speaker-external information update process of people telling him that *p* (hearsay), or by a Speaker-internal information update process of inference on the basis of contextual clues. In both accomplishments and hearsay/ inference evidentials, the final stage s_f is different from the stages preceding it in the sense that it represents a endpoint. With evidentials expressing inference, there is a mental process of gradual 'building up' of the information by the speaker that culminates in the speaker possessing the relevant information expressed in *p*. With hearsay evidentials, the speaker is the recipient of information, and as such positioned at the final stage of a process of transfer of information initiated by a third party. In both cases, the speaker does not have direct access to the information. This explains why only *indirect* evidentials such as hearsay and inference can be expressed by the present perfect: the fundamental structure of this stage type requires the end point s_f to be different from the preceding ones. Direct evidentials most likely do not involve a process, but require direct sensory perception.

The difference between hearsay and inference is mirrored in the aspectual classes of epistemic verbs whose meanings are close to the evidential values of inference and hearsay. The evidential process of inference can be usefully compared to epistemic verbs such as *infer*, *conclude*, or *deduce*: these are accomplishments in which the final stage of the inference, conclusion, or deduction is different from the preceding ones in that it *completes* the event. The dictionary meaning of these verbs confirms that interpretation: *infer* and *conclude* are commonly defined as ‘to form an opinion on the basis of evidence’. At the same time, the inference, conclusion, or deduction ‘under development’ is part and parcel of every stage of the process. Verbs like *infer*, *conclude*, or *deduce* can therefore be viewed as representing the aspectual counterparts of the evidential process of inference, where the final information stage is the result of gradually ‘building up’ and ‘completing’ this information stage on the basis of contextual clues. Similarly, the evidential information update structure of hearsay is similar to the aspectual structure of verbs such as *tell* or *learn*. In *John told Mary a story*, the verb *tell* is an accomplishment involving a process of information transfer with *Mary* as its final recipient. In hearsay, the Speaker likewise is the final recipient of information transferred to him/her by an unspecified third party.

The evidential counterpart of achievements can be found in mirativity: both cases involve a sudden transition from one information stage to another, without a process mediating this transition.[8] We assume, following Adelaar (1977, 2013) and Mexas (2016), that the basic grammatical meaning of miratives is that of 'sudden realization'. The meaning of realization involves an abrupt change of information: the verb *realize* itself belongs in the aspectual class of achievements. We formalize this idea by using the basic structure of the present perfect for achievement verbs in (15), again substituting events with information updates:

(20) *Mirativity*
$s_{Mir} = \{s \mid < s_i, s_f > \subset S\}$
$\lambda s.\lambda i_u$ ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

The 'abrupt' aspect of mirativity also accounts for the notion of 'unprepared mind' that is often used in connection with mirativity (Slobin & Aksu 1982, Peterson 2011): new information suddenly intrudes on the mind to the Speaker without preparation. We would like to argue that the notion of 'unprepared mind' is a mere epiphenomenon of a more fundamental aspect of mirativity, namely the sudden change from one information stage to another. The lack of preparation that seems inherent in miratives derives from the absence of a process of information stages leading up to the final information stage that is typical for indirect evidentiality. We propose, following Mexas (2016), that the interpretation of surprise can be derived from the core meaning of sudden change in the form of a pragmatic implicature: an sudden change from one information stage to another can be pragmatically interpreted as a surprise given the right context.

How does this analysis account for the portmanteau cases in Washo (2) and Hare (3) above, where a single morpheme expresses both indirect evidential and mirative meanings? Under our analysis, this simply means that the relevant morphemes are underspecified in a specific way. When a morpheme can express both evidential and mirative meanings, such as Hare *lõ* or Washo *-áʔyiʔ,* it is underspecified for the presence of a process $< \mathbf{S_i}, S_j, S_k, S_l >$. This underspecification means that, if the information state update involves a process, the morpheme will be associated with an indirect evidential meaning, while if it lacks such a process (or the context precludes it), the mirative meaning will emerge.[9] This is formalized as follows, with the dots between between s_i and s_f in the ordered set again indicating the optional presence of additional stages:

(21) *Indirect evidentiality/ mirativity*
$s = \{s \mid < s_i, ..., s_f > \subset S\}$
$\lambda s.\lambda i_u$ ($s < t_{Sp}$*) and s_f and i_u hold at t_{Sp}*

[8] Note that on the evidential/ mirative level, we strictly refer to epistemic *information* stages, or stages of knowledge: a (polar) transition from a state of lack of knowledge to a state of knowledge. These should not be confused with stages of *certainty*, which is a gradable epistemic notion.

[9] Various factors can influence the interpretation of the portmanteau morpheme as aspectual, evidential, or mirative. DeLancey (1997:39) notes that perfect aspect favors the inferential/ hearsay interpretation of Hare *lõ*, while imperfective has mirative as its normal interpretation. Izvorski (1997:223) observes that when Turkish *-mIş* is involved in the formation of the past or the future perfect, the interpretation of evidentiality does not arise. We take these observations to be essentially compatible with the analysis presented here.

Morphemes can also be underspecified for the type of stage (event stage vs information stage): this is the case for Turkish morpheme *-mIş*, which can express perfect aspect, indirect evidentiality, and mirativity: this is possible because *-mIş* is underspecified for both the type of stage and for the presence of a process. Once again, we formalize this insight by underspecifying the formula as to whether stages map to events or information updates:

(22) *Present perfect/ indirect evidentiality/ mirativity*
$s = \{s \mid < s_i, ..., s_f > \subset S\}$
λs ($s < t_{Sp}$*) and s_f holds at t_{Sp}*

The morpheme *-mIş* is primarily sensitive to the presence of a final stage s_f holding at utterance time, regardless of its status as an information stage or an event stage.

4. Conclusion

In this paper, we have shown that the relation between perfect aspect, indirect evidentiality in hearsay and inference, and mirativity/ 'realization' can be best understood as the result of an underlying template involving stages that can be interpreted either in terms of event stages or as information stages.

Although this paper does not intend to make any typological claims, its arguments could be of value for the study of the typology and the grammaticalisation of evidentiality. In a number of languages, evidential and mirative meanings seem to be derived from core aspectual morphemes rather than the other way around. This 'directionality' of the relationship between aspect and evidentiality is corroborated by an implicational relation in the languages of the world: the set of languages in which perfect aspect can also express evidential meanings is a subset of the languages that express perfect aspect with a strictly aspectual meaning. The lexical template for stages that we proposed in (12), which is unspecified for event or information stages, could be viewed as the result of 'bleaching' the event-related feature out of event stages, so that they can be used to represent information stages. We will leave this topic for further research.

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