The landscape of inferential evidentiality: Towards a unified framework[1]

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Abstract. Inferential evidential markers (IEMs) in assertions indicate that the speaker inferred ϕ from a set of privileged knowledge (e.g. from facts that the speaker witnessed directly). As the intuition that 'inferencing took place' is typical for IEMs, a uniform analysis in terms of inferencing seems warranted. The attested logical properties of IEMs, however, can differ substantially from language to language, which led to a multitude of incommensurable accounts. I propose a unified underlying framework which (a) captures the implicitly assumed inferencing in IEMs and (b) can be modulated so as to capture IEMs of different logical strength in a common framework. The model builds on von Fintel + Gillies' (2010, 2021) kernel model and can be adapted to account for German *wohl*, Gitksan *=ima* and Cuzco Quechua *=chá*.

Keywords: defeasible inference, kernel, epistemic modals, entailment, Cuzco Quechua, Gitksan, German, particles.

1. Introduction

In recent years, evidential markers have been described in many languages (Aikhenvald, 2004; SanRoque et al., 2017). While their morphosyntactic status differs from language to language, their shared semantic contribution is to mark an assertion as information that the speaker has inferred (rather than witnessed herself). Current analyses phrase this speaker intuition in many different ways: Some advocate an analysis in terms of classical logic (von Fintel and Gillies 2004, 2021; Paprafragou, 2006), some use score-board models (Faller, 2023), generic entailment (Kratzer, 1991), defeasible inference (Eckardt, 2020) or modal analyses (Matthewson, 2011). Other authors coin properties of propositions like *new environmental information* (Peterson, 2016), ASSUME (Zimmermann, 2008, 2011; deVeaugh-Geiss, 2014) or INF (Göbel, 2018), leaving a detailed definition to future work. As evidentials in different languages show different logical properties, a plurality of accounts seems indeed justified. Yet, we should also capture the concept of inferencing in a uniform manner. The present paper surveys four inferential evidential markers (IEMs) and proposes a uniform framework that aims to account for the similarities as well as differences between these markers. These are our cases:

English *must,* German *muss*

(1) Bobby sees people coming in with wet rain gear and knows rain is the only explanation.
Bobby: It **must** be raining. (von Fintel and Gillies, 2021)
Bobby: Es **muss** regnen. (Kratzer, 1991)

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German *wohl*

(2) Context: Bobby passes Hein's house. The windows are closed and locked. Bobby knows that Hein is a mariner and often leaves his home for weeks.
Bobby: Hein ist **wohl** auf See.
Hein is wohl at sea
'Hein is at sea I guess' (Eckardt, 2020)

Gitksan =*ima* (Tsimshianic)

(3) Context: You look in the fridge for some hoxs (fish) to make soup, and it's gone.
gub-i-(t)=**ima**=s Sheila=hl hoxs.
eat-TR-3=INFER=PND Sheila=CND hoxs
'Sheila might've eaten the hoxs.' (Littell et al. 2010: ex (24))

Cuzco Quechua =*chá*

(4) Context: The speaker knew 'him' in her childhood and estimates his age.
*Suqta chunka wata-yuq ka-sha-n=**chá**.*
six ten year-POSS be-PROG-3=CONJ
'He must be sixty years (old)' (Faller, 2002:172, quoted after Faller, 2023:146)

All four items were described as marking information as inferred rather than directly witnessed. My starting point is von Fintel and Gillies' account for *must* as IEM (von Fintel and Gillies, 2010, 2021). I argue that their analysis is too restrictive and propose a generalised version, which will then be adjusted to German *wohl* (Eckardt and Beltrama, 2019; Eckardt, 2020)), Gitksan =*ima* (Littell et al. 2010; Peterson, 2010; Matthewson, 2011) and Cuzco Quechua =*chá* (Faller 2002, 2011, 2023).

2. Inferential *must*

2.1. von Fintel + Gillies

What is the difference between asserting ϕ and *must* ϕ with epistemic *must*? The minimal contrast in (5) and (6) was argued to show that epistemic *must* signals inferred information (von Fintel and Gillies, 2010; Goodhue, 2017).

(5) Context 1: Bobby sees people coming in with wet rain gear and knows rain is the only explanation.
a. It is raining.
b. It **must** be raining.

In Context 1, Bobby can utter both (a) and (b). Specifically, *must* ϕ can be used if the speaker has evidence that allows her to infer ϕ, but has not directly witnessed ϕ. Intuitions change when Bobby witnesses the rain directly.

(6) Context 2: Bobby looks out of the window. Rain is pouring down.
a. It is raining.
b. #It must be raining.

If Bobby directly witnesses the rain, she cannot assert (6b). Taking this and other observations on *must* into account, von Fintel and Gillies (2010, 2021) propose the following analysis.

(7) A ***kernel*** $\boldsymbol{K^c}$**(w)** in a context *c* at a world *w* is a non-closed set of propositions, those that are direct (enough) information at *w* in c. An epistemic modal base B^c(w) in *c* at w is determined by K^c(w) iff $\cap K^c(\mathrm{w}) = B^c(\mathrm{w})$.

(8) Definedness and truth conditions of *must* ϕ[2]
$[\![\textit{must}\ \phi]\!]^{c,w}$ is defined if $K^c(w)$ doesn't settle $[\![\phi]\!]^c$
$= 1$ if $B^c(\mathrm{w}) \subseteq [\![\phi]\!]^c$
$= 0$ if $B^c(\mathrm{w}) \setminus [\![\phi]\!]^c \neq \emptyset$
$[\![\textit{must}\ \phi]\!]^{c,w}$ is undefined if $K^c(w)$ settles $[\![\phi]\!]^c$,
i.e. if there is a proposition $p \in K^c(w)$ such that $p \subseteq [\![\phi]\!]^c$ or $p \cap [\![\phi]\!]^c = \emptyset$

The analysis rests on the idea that the kernel $K^c(w)$ collects propositions that sp(c) has directly witnessed (e.g., people in wet raingear). $K^c(w)$ is not closed under entailment, i.e. it does not contain propositions that follow from the witnessed facts. Therefore, the kernel can only settle ϕ if ϕ was directly observed. The epistemic modal base *B* serves to model the inferences drawn from directly witnessed facts. Von Fintel and Gillies' argue that *must* expresses strong necessity; it should not be modelled as universal quantification over restricted sets of worlds (*pace* Kratzer 1991). Their analysis predicts that *must* ϕ entails ϕ (contrary to intuitions that ϕ is 'not asserted for certain'; Lassiter, 2016; Goodhue, 2017). They also stress that *must* ϕ does not trigger uncertainty as Gricean implicature (*pace* Mandelkern, 2019). While they offer convincing examples to illustrate the strength of *must*, other (authentic) examples seem to challenge their predictions and the diagnosis that *must* is always used in a strong sense can only be defended with additional rescue measures (see von Fintel and Gillies, 2021 for details).

2.2. What does it mean to be 'direct enough information for ϕ'?

The following example shows that *must* ϕ can be used in a strong sense (vFG 2021, ex. (4)).

(9) **Ball-in-the-box** context: Bobby has direct evidence / $K^c(w)$ includes
a. The ball is in box A, B or C.
b. The ball is not in box A.
c. The ball is not in box B.
Bobby can say: *The ball must be in box C.*

Bobby's assertion doesn't perspire any uncertainty; she concludes from direct evidence. Direct evidence for (b) and (c) could be: Bobby opened the boxes and found them empty. Direct evidence for 'the ball is in box A, B or C' needs a bit more imagination, but let us assume that

[2] von Fintel and Gillies (2021) allow for an alternative definition for *K settles* ϕ*.* As it doesn't make a difference for the present purpose, I leave it aside for the sake of clarity.

Bobby got a slip of paper from the instructor, saying ‘the ball is in A, B or C’. — In (10), however, such instructions have a different status:

(10) **Airbnb** context: Alex and Bobby have rented an Airbnb flat. The landlord sent them an email saying “The key is under the doormat.” Alex and Bobby approach the flat. Bobby: ^{ok}*The key must be under the doormat.*

Bobby can use *must* in (10). Therefore, the kernel $K^c(w)$ in (10) may not contain *p* = ‘the key is under the doormat’. Otherwise, we would predict that the utterance is ill-formed. A suitable kernel for (10) could be as in (11).

(11) $K^c(w)$ = { p_1 ≔ ‘The landlord said that the key is under the doormat’,
p_2 ≔ ‘Landlords don’t lie’ }

This kernel contains directly witnessed information (p_1), and no single proposition in $K^c(w)$ settles ϕ. However, p_2 looks like generic knowledge, not a fact that Bobby directly witnessed.[3] If we return to the **ball-in-the-box** context, it turns out that such generic assumptions also play a role: If the landlord’s uttering *p* doesn’t constitute direct evidence for *p,* then the slip of paper saying (i) doesn’t constitute direct evidence for (i), either.

(12) **Ball-in-the-box** context (revised)
$K^c(w)$ includes:
a. The instructor gave me a slip of paper saying, ‘the ball is in box A, B or C’.
b. Experimental instructors don’t lie.
c. The ball is not in box A.
d. The ball is not in box B.

Examples (9) and (10) show that additional knowledge is in play, *pace* von Fintel and Gillies.[4] I propose to generalize the notion of *kernel* to include general world knowledge.

2.3. A revised version of von Fintel and Gillies

We found contexts where the *directly witnessed* propositions in kernel $K^c(w)$ are insufficient to entail ϕ, unless we add general world knowledge: Definition (7) assumes that the epistemic modal base *B* is derived from the kernel by intersection $\cap K^c(w) = B^c(w)$. Thus, *B* is not informed by additional knowledge of the speaker. *B* only serves the purpose of deriving the inferential closure of $K^c(w)$. Nevertheless *must* ϕ was felicitous in such contexts. We must allow for additional world knowledge, as spelled out in (13).

(13) **$KK^c(w)$** ‘kernel with further knowledge of the speaker in c’
Assume a context *c* with proposition ϕ at issue (i.e. sp(c) plans to assert ϕ).

[3] The scenario can be sharpened if we assume that this was the first Airbnb landlord they ever met, or that they had experienced only loonly landlords before.
[4] von Fintel and Gillies could argue that the slip of paper is direct enough in (9) but the email in (10) is not direct enough in (10). But this move feels like a backward diagnosis, where the label ‚direct enough‘ follows from, rather than predicts the use of *must.*

A **kernel with general knowledge** $\mathbf{KK^c(w)}$ is a non-closed set of propositions of relevant speaker information about ϕ.

(14) The meaning of *must* ϕ (to be revised)
Let $\mathbf{KK^c(w)}$ be the speaker's kernel with general knowledge for ϕ.
$\mathbf{KK^c(w)}$ must include a non-empty subset of directly witnessed facts $\mathbf{K^c(w)}$.
$\mathbf{KK^c(w)}$ defines an epistemic base: $\cap\mathbf{KK^c(w)} = B^c(w)$.
$[\![$ *must* $\phi]\!]^{c,w}$ is only defined if the witnessed facts $\mathbf{K^c(w)}$ don't settle $[\![\phi]\!]^{c,w}$.
$[\![$ *must* $\phi]\!]^{c,w} = 1$ if $\mathbf{KK^c(w)}$ entails* $[\![\phi]\!]^{c,w}$, *in terms of the strongest possible entailment that the premisses allow.
$[\![$ *must* $\phi]\!]^{c,w} = 0$ if $\mathbf{KK^c(w)}$ does not entail* $[\![\phi]\!]^{c,w}$.
$[\![$ *must* $\phi]\!]^{c,w}$ is undefined if $K^c(w)$ settles $[\![\phi]\!]^{c,w}$, i.e. there is $p \in K^c(w)$ such that $p \subseteq [\![\phi]\!]^{c,w}$ or $p \cap [\![\phi]\!]^{c,w} = \emptyset$.

The definition uses von Finel and Gillies' kernel to exclude *must* ϕ if ϕ was directly witnessed. Yet, we allow further knowledge in the set $KK^c(w)$. A possible paraphrase of *must* ϕ could thus be "I didn't witness ϕ directly, but ϕ follows from what I *saw and what I know otherwise.*" The proposal opens the possibility to treat weak and strong uses of *must* in a uniform manner. To see this, let us return to the Airbnb context.

2.4. The loony landlord

Under the new version, we can analyse (10) with the $KK^c(w)$ in (11), repeated here.

$KK^c(w) = \{ p_1 \coloneqq$ 'The landlord said that the key is under the doormat',
$p_2 \coloneqq$ 'Landlords don't lie' $\}$

Proposition p_2 is a generic statement. Therefore, $\cap KK^c(w)$ entails 'the key is under the doormat' only under the tacit assumption *that this landlord has the normal landlord properties*. If the speaker draws inferences from generic premises, she must adopt tacit normality assumptions. We thus predict that the logical strength of *must* ϕ depends on the nature of premises. In the ball-in-the-box context, we know that experimental instructors do not lie and experiments are prepared carefully. We are, therefore, justified to treat 'The ball is in box A, B or C' as a known fact. In contexts where the KK-kernel doesn't include any generic premises, we predict that *must* ϕ logically entails ϕ. The strenght of inferences hinges on the strength of premises. The approach can thus potentially explain the intuition that in some contexts, the assertion *must* ϕ feels less certain than the assertion ϕ (Lassiter, 2016; Goodhue, 2017; Mandelkern, 2019).

How about an Airbnb context where Bobby knows that the landlord gave false information before? To my intuition, Bobby can no longer say *The key must be under the doormat* but must use a more hedged form, e.g., *The key should be / allegedly is …* . If Bobby has evidence ψ against the tacit normality assumption, then her knowledge set $KK^c(w)$ must include ψ. This is captured by the notion of **exhaustive kernels**.

(15) Let $\mathbf{KK^c(w)}$ be the speaker's kernel with general knowledge for ϕ.

KK^c(*w*) is **exhaustive** iff there is no larger set of speaker knowledge $H^c(w)$ such that **KK^c(*w*)** $\subset H^c(w)$ and $H^c(w)$ entails $\neg\phi$, or $H^c(w)$ entails neither ϕ nor $\neg\phi$.

An exhaustive **KK^c(*w*)** will thus ensure that, if the speaker knows that the landlord is a loony landlord, then this information is part of the exhaustive **KK^c(*w*)**. Or, in other words, if an exhaustive **KK^c(*w*)** doesn't say that the landlord is loony, the speaker believes that he isn't. This leads to the final proposal for the use of *must* ϕ.

(16) The meaning of *must* ϕ (final version)
The speaker has a kernel with general knowledge **KK^c(*w*)** for ϕ.
KK^c(*w*) includes a non-empty subset of directly witnessed facts $K^c(w)$.
KK^c(*w*) is exhaustive.
KK^c(*w*) defines an epistemic base: $\cap$**KK^c(*w*)** $= B^c(w)$.

$[\![$ *must* ϕ $]\!]^{c,w}$ is only defined if the witnessed facts **K^c(*w*)** don't settle $[\![\phi]\!]^{c,w}$.
$[\![$ *must* ϕ $]\!]^{c,w} = 1$ if **KK^c(*w*)** entails* $[\![\phi]\!]^{c,w}$, *in terms of the strongest possible entailment that the premisses allow.
$[\![$ *must* ϕ $]\!]^{c,w} = 0$ if **KK^c(*w*)** does not entail* $[\![\phi]\!]^{c,w}$.
$[\![$ *must* ϕ $]\!]^{c,w}$ is undefined if $K^c(w)$ settles $[\![\phi]\!]^{c,w}$, i.e. there is $p \in K^c(w)$ such that $p \subseteq [\![\phi]\!]^{c,w}$ or $p \cap [\![\phi]\!]^{c,w} = \emptyset$.

If we restricted attention to *must* in English, we could easily include exhaustivity in the definition of KK^c(w). However, it turns out that IEMs in other languages pose different requirements on KK^c(w). The semantic analyses of these IEMs use different restrictions on KK^c(w), as we will see in the next sections in the discussion of German *wohl,* Gitksan *=ima* and Cuzco Quechua *=chá*.

3. Aligning *must* and German *wohl*

3.1. German *wohl*

Zimmermann (2008) provides the first formal semantic analysis of the particle *wohl* in assertions and questions. He draws attention to the minimal contrast in (17a/b).

(17) a. Bobby passes Hein's house. Hein is a mariner. The windows of his house are closed and locked, his car is not parked in front of the house.

Bobby: Hein ist **wohl** auf See.
Hein is wohl on sea
'Hein is at sea I guess'

b. Bobby and Hein are on a marine cruise. They are seated on two deck chairs, and Bobby is talking to Hein's mother on the phone.

Bobby: *Hein ist **wohl** auf See ('Hein is **wohl** at sea')
^{ok}Hein ist auf See. ('Hein is at sea')

Zimmermann concludes that in a context where the speaker is fully certain that ϕ holds true, she cannot assert *wohl* ϕ. Later authors refine this picture and observe that *wohl* ϕ expresses that the speaker infers ϕ from direct evidence (Göbel, 2018; Beltrama and Eckardt, 2019; Eckardt, 2020). Example (17a) illustrates this intuition: Bobby's utterance is justified by clues like the locked windows or the missing car. (17b) is incoherent, as Bobby witnesses ϕ directly.

German *wohl* contrasts with epistemic *muss*. Let me briefly compare these two markers, starting with the *muss* example (18) which is the counterpart to English (1).

(18) Bobby sees people coming in with wet rain gear and knows rain is the only explanation.
Bobby: *Es* ***muss*** *regnen.*
It must rain
'It must be raining.'

In this context, Bobby infers the prejacent 'it must be raining' from the witnessed fact that people come in wearing wet rain gear. A natural context to use *Es regnet wohl* rests on evidence that *suggests* but does not *prove* that it is raining, as illustrated in (19).

(19) Bobby is indoors, the blinds are down. Rain was announced in the weather forecast. It's around noon and has become considerably darker outside over the last half hour.
Bobby: *Es* *regnet* ***wohl***.
it rains wohl
'I guess it is raining.'

The evidence in (19) suggests that it is raining, but lacks the conclusive evidence of (a lot of) water, indicating rain in (18). Eckardt (2020) implements the tentative nature of *wohl* ϕ in the following way: I propose that *wohl* ϕ can be uttered in context *c* iff the speaker in *c* has relevant knowledge that defeasibly entails ϕ. The speaker's knowledge must, moreover, be exhaustive and include direct evidence as well as general world knowledge. The analysis can easily be spelled out following the scheme of Section 2.

(20) ⟦ *wohl* ϕ ⟧^{c,w} is defined iff there is a kernel with general knowledge $\mathbf{KK^c(w)}$ such that
$\mathbf{KK^c(w)}$ includes a non-zero set of direct evidence $K^c(w)$
$\mathbf{KK^c(w)}$ is exhaustive (for ϕ).
$\mathbf{KK^c(w)}$ doesn't logically entail ϕ (in the sense of strict entailment)

⟦ *wohl* ϕ ⟧^{c,w} = 1 if $\mathbf{KK^c(w)}$ defeasibly entails ϕ.
⟦ *wohl* ϕ ⟧^{c,w} = 0 otherwise.

Defeasible entailment is defined in the Kratzer/Lewis definition (21) (Lewis, 1973) . The relation STEREO$^{c}_{w}$(w') is true iff world *w'* is a stereotypical world (in terms of relevant matters – e.g., in terms of what landlords are like).[5]

5 The best label for this selection of worlds could be debated – other authors call these worlds *inertia worlds* or *worlds closest to the real world* or *normal worlds.* For the sake of coherence, I use the same label as in earlier work.

(21) **KK^c(w)** defeasibly entails ϕ iff

$\forall w'(\text{STEREO}^c_w(w') \wedge \cap KK^c_w(w') \rightarrow \phi(w'))$

'In all worlds *w'* that are stereotypical (according to the speaker's standards) and all premises in KK^c(*w*) hold true, ϕ is also true in *w*.'

Let us see how this works out in example (19).

(22) Context *c*, Bobby utters: *Es regnet wohl.*

a. KK^c(*w*) = { 'it became dark outside', 'dark clouds mean rain', 'it is around noon', 'dusk falls at 7 pm', …} = kernel with general knowledge

b. K^c(*w*) = { 'it became dark outside', 'it is around noon' } = witnessed facts

c. KK^c(*w*) doesn't logically entail ϕ (specifically, $\phi \notin$ K^c(*w*)). Therefore, the utterance is defined.

d. $\forall w'(\text{STEREO}^c_w(w') \wedge \cap KK^c_w(w') \rightarrow \text{it-is-raining}(w'))$
'in all stereotypical worlds where it turns dark around noon, although dusk is not expected before 7 pm, it is raining.'

Bobby's KK does not logically entail ϕ. The utterance is thus defined. Yet, Bobby's knowledge entails that the visible evidence entails rain *under typical circumstances*. The logical difference between *Es* ***muss*** *regnen* and *Es regnet* ***wohl*** is, hence, very subtle.

Yet, the real difference between German *wohl* ϕ and *muss* ϕ could be a difference in the speaker's attitude towards the asserted content. In (18), Bobby is prepared to argue that ϕ is true. In (19), Bobby tentatively asserts that ϕ but is prepared to withdraw ϕ in light of further evidence. A bolder self of Bobby in (19) could equally well assert *Es muss regnen*, believing that the available evidence is good enough to make a case. The different use-conditional signals sent by *muss* and *wohl* in German need to be explored in detail.[6]

The present, nuanced account of varieties of IEMs also explains why Kratzer's original analysis of German *muss* resembles the account of *wohl* ϕ, although the two markers differ in logical strength (Kratzer, 1991; Eckardt ,2020). In Section 2, we assumed that *muss* ϕ indicates that KK^c(w) entails ϕ in the strongest form permitted by the premiss set KK^c(w). Kratzer (1991) is tailored for the weak premiss sets, while von Fintel and Gillies (2021) restrict attention to the strongest possible premiss sets KK^c(w). German *muss* ϕ conveys that 'My knowledge entails ϕ in the strongest possible sense', whereas German *wohl* ϕ conveys that 'from what I know, it (stereo)typically follows that ϕ'. The differences in logical strength are echoed in the use-conditional content of *muss* ϕ and *wohl* ϕ in German. The next section discusses the IEM =*ima* in Gitksan, which exhibits yet different logical properties.

[6] German newspaper texts routinely use *wohl* to mark an assertion as a conjecture rather than an established fact.

4. Gitksan: Non-exhaustive kernels

4.1. Gitksan =*ima* (and a glance at =*n'akw*)

The Gitskan morpheme =*ima* was described as an epistemic evidential (Peterson, 2008, 2010; Littell et al. 2010; Matthewson, 2011). One of its most striking features is that it can be used with variable quantificational force. In consequence, Gitksan examples *ima*-ϕ are sometimes translated as English inferential *must* ϕ and sometimes as *might* ϕ. The following examples from Peterson (2010) illustrate the contrast.

(23) the **fishing** scenario (Peterson 2010: 7, ex (9))

yukw=**ima**=hl	iixw-(t)=s	John.
PROG=MOD=CN.det	fish-3=CN.det	John

Speaker's direct evidence:
{John's rubber boots are missing; his truck is not in the driveway; it's fishing season}

Speaker's general world knowledge:
{Rubber boots are used for fishing; rubber boots are not ideal for hunting}

a. 'John **must** be fishing.' (best translation)
b. 'John might be fishing.' (less plausible translation)

In the given situation, the translation with *must* (23a) is the best way to render the speaker's message in English. Matters are different in the next example.

(24) the **talking uncle** scenario (Peterson 2010: 4, ex. (6))
Speaker and addressee watch the speaker's uncle talking to some strangers.
Speaker says:

*wilaa-i-(t)=**ima**=s*	*nipip-y'*	*n'itiit.*
know-TR-3=MOD=PN.det	mother's.brother-1SG	3PL

a. 'My uncle **might** know them.' (best translation)
b. 'My uncle must know them.' (less plausible translation)

Here, *might* provides the better translation. A survey of examples in (Peterson, 2008, 2010; Matthewson, 2011) suggests that whenever there is plausible evidence for ϕ, Gitksan ϕ=*ima* is translated as *must* ϕ. Possibility readings emerge in contexts where it is unclear what should trigger the inference. Peterson (2008) adds Gitksan =*n'akw* as a further point of comparison. He observes that =*n'akw* is more clearly an inferential evidential; it necessarily requires sensory evidence and that "when you have the appropriate context to use either =*n'akw* or =*ima* – one that has sensory evidence – =*n'akw* is somehow 'stronger' than =*ima*" (§3). We thus find a competition similar to the one between German *muss* and *wohl.* In the following, I focus on =*ima.*

I propose that Gitksan =*ima* can also be analysed with knowledge kernels **KK.** It allows for kernels that are not exhaustive and can include *frequently*-rules. Gitksan =*ima* can then be integrated in the present framework as follows.

(25) Gitksan ⟦ *ima* ϕ ⟧^{c,w}
⟦ *ima* ϕ ⟧^{c,w} is defined iff there is a kernel with general knowledge **KK^c(w)** such that
KK^c(w) can include direct evidence $K^c(w)$.
KK^c(w) doesn't logically entail ϕ.
KK^c(w) need not be exhaustive.
⟦ *ima* ϕ ⟧^{c,w} = 1 if **KK^c(w)** entails* ϕ *in terms of the strongest possible sense that the premisses allow.
⟦ *ima* ϕ ⟧^{c,w} = 0 otherwise.

Thus, depending on the premises in $KK^c(w)$, the assertion *ima*-ϕ will be more or less strong. We first show the derivation of the fishing example (23).

(26) *ima* John is fishing.

a. **KK^c(*w*)** = { 'John's rubber boots are missing', 'his truck is not in the driveway', 'it's fishing season', 'rubber boots are used for fishing', 'rubber boots are not ideal for hunting'}

b. $K^c(w)$ = { 'John's rubber boots are missing', 'his truck is not in the driveway', 'it's fishing season' }

c. **KK^c(w)** doesn't logically entail ϕ (specifically, $\phi \notin K^c(w)$)
→ The sentence is defined.

d. $\forall w'(\text{STEREO}^c_w(w') \wedge \cap \mathbf{KK}^c_w(w') \rightarrow \text{John-is-fishing}(w'))$
'in all stereotypical worlds where all propositions in $KK^c(w)$ are true, John is fishing.'

The kernel $KK^c(w)$ includes generic statements, e.g., the properties of rubber boots are generic, not natural laws. We therefore predict that ϕ is defeasibly entailed. The speaker grants that there are non-stereotypical worlds w' where $KK^c_w(w')$ holds true and John is cleaning the neighbour's swimming pool. Let us compare this with the analysis of (24), the talking uncle.

(27) *ima* my uncle knows them.

a. **KK^c(*w*)** = { 'If you talk to someone, you <u>often</u> know each other', 'The uncle is talking to two strangers'}

b. $K^c(w)$ = { 'The uncle is talking to two strangers' }

c. **KK^c(w)** doesn't logically entail ϕ ($\phi \notin K^c(w)$) → The sentence is defined.
d. <u>Many</u> $(\lambda w'.\text{STEREO}^c_w(w') \wedge \cap \mathbf{KK}^c_w(w')\ ;\ \lambda w'.\text{my-uncle-knows-them}(w'))$

I assume that the knowledge base $KK^c(w)$ includes the weak generalization 'if you talk to someone, you *often* know them', and this premise is not sufficient to infer 'my uncle knows them'. We can at best infer (d), 'in <u>many</u> stereotypical worlds where all propositions in $KK^c(w)$ are true, my uncle knows the strangers.' The tacit normality assumption in this case must be 'let us assume that we are in one of these – frequent enough – normal worlds.' That is, we can only force ϕ to follow from $KK^c(w)$ by a *tacit domain restriction*. The analysis hence assumes variable qunatificational domains, a central element of earlier modal accounts of Gitksan evidentials (for modals of variable quantificational force, see Matthewson et al. 2007). The present proposal, however, integrates the assumption into a general framework where *inferred* information is the common message of IEMs.

In his discussion of (24), Peterson comments, "there is no reason why the speaker's uncle *must* know the people he's talking to". We captured this intuition by assuming that $KK^c(w)$ can contain *frequently*-rules. Moreover, $KK^c(w)$ is not exhaustive: There are larger sets $H^c(w)$ with further relevant knowledge, e.g., 'If tourists ask you for advice, you often talk to them'. It is crucial to work with a non-exhaustive $KK^c(w)$ rather than some larger set: These wouldn't be suited to support the weak inference 'My uncle knows them'. Here is why. Assume a knowledge base H that includes both {'often, if you talk to people you know them', 'often if tourists address you, you'll talk to them (even if they are strangers)'. A random world in match with these two frequently-rules could equally well be one where the uncle talks to tourists or where the uncle talks to acquaintances. Hence, even if we restrict attention to the worlds most in line with H we cannot infer that 'My uncle knows them'. Choosing a non-exhaustive set $KK^c(w)$, the speaker decides to dwell on one option to the neglect of others.

Let me summarize: Gitksan allows knowledge bases $KK^c(w)$ with *frequently*-rules. These $KK^c(w)$ are often also *non-exhaustive*: The speaker wants to leave aside alternative explanations and focuses on one possibility. The advantage of the present proposal – as compared to accounts in terms of variable modal force – is that the nature of the premises and the strength of the inference are directly related. This accounts for the overlapping contexts of use for *=ima* and *=n'akw*, as well as their different nuances in logical strength. For reasons of space, I leave a detailed discussion of *=n'akw* for another occasion.

5. Cuzco Quechua: Alternative Kernels allowed

5.1. Cuzco Quechua -*chá*

The morpheme *=chà* in Cuzco Quechua was described as inferential evidential in (Faller, 2011; Cusihuaman, 2001). Faller observes that it can be used when the speaker is drawing an inference from well-established premises, but also when s/he is merely guessing or speculating (Faller, 2002:171). Floyd classed *chá* ϕ as "hypotheses that are advanced about some unexperienced or uncorroborated state of affairs." (Floyd, 1999:100, quoted after Faller 2002). (28) shows an inferential use.

(28) Context: The speaker (…) saw someone come into the building with a wet raincoat.
Para-sha-n-**chá**.
rain-PROG-3-**chá**

‘It must be raining.’ (Faller 2002, (132) and comments)

In a context where well-established premises are given, the assertion *ϕ-chá* can be translated as *must ϕ*. In other contexts, however, *ϕ-chá* is used in a weaker sense to convey guesses or conjectures. Faller (2023), in contrast, describes assertions *ϕ-chá* as *conjectures*. This revision is suggested by examples like (29) where *chá* is used with *ϕ* and ¬*ϕ* in coordination (Faller 2011, 2023).

(29) A: Inés-cha=qa hamu-nqa?
Inés-DIM=TOP come-3FUT?
‘Will Inés come?’
B: *Icha=pas=**chá**, mana=pas=**chá**.*
maybe=ADD=CONJ, not=ADD=CONJ.
‘Maybe, maybe not.’ (Faller 2011, (25))

B’s utterance shows that *p=chá and non-p=chá* are consistent. This aligns *=chá* with possibility adverbs in English, like *perhaps, maybe* and *possibly*.

I pursue the hypothesis that the intuitions about reasoning are orthogonal to the logical strength of an evidential marker.[7] We can attenuate logical strength (a) by the strength of the premises used, (b) by the strength of logical entailment (classical vs. defeasible) and (c) by the properties of the knowledge set $KK^c(w)$ in use. Specifically, so far we assumed that only one set $KK^c(w)$ was in play. Examples like (29) suggest that Cuzco Quechua speakers can refer to two alternative knowledge bases $KK^c(w)_1$, $KK^c(w)_2$ when using *chá*.

(30) Analysis of *ϕ=chá* (Cuzco Quechua):
⟦ *ϕ=chá* ⟧^{c,w} is defined iff there is a kernel with general knowledge $\mathbf{KK^c(w)_1}$ such that $\mathbf{KK^c(\mathit{w})_1}$ may or may not include direct evidence $K^c(w)$.
$\mathbf{KK^c(\mathit{w})_1}$ doesn’t logically entail *ϕ*.
$\mathbf{KK^c(\mathit{w})_1}$ can be non-unique. There can be an alternative kernel $\mathbf{KK^c(\mathit{w})_2}$.
⟦ *ϕ=chá* ⟧^{c,w} = 1 if $\mathbf{KK^c(\mathit{w})_1}$ defeasibly entails *ϕ*. ($\mathbf{KK^c(\mathit{w})_2}$ can defeasibly entail ¬*ϕ*.)
⟦ *ϕ=chá* ⟧^{c,w} = 0 otherwise.

The following is a provable fact: If $\mathbf{KK^c(\mathit{w})}$ is not unique then $\mathbf{KK^c(\mathit{w})_1}$ or $\mathbf{KK^c(\mathit{w})_2}$ are not exhaustive. Assume $\mathbf{KK^c(\mathit{w})_1}$ was exhaustive, and defeasibly entailed *ϕ*. Then $\mathbf{KK^c(\mathit{w})_1} \cup \mathbf{KK^c(\mathit{w})_2}$ must defeasibly entail *ϕ*. As $\mathbf{KK^c(\mathit{w})_2}$ defeasibly entails ¬*ϕ*, $\mathbf{KK^c(\mathit{w})_2}$ cannot be exhaustive.

Let us see how alternative kernels lead to utterances *ϕ=chá* that have the logical strength of possibility statements. (31) shows the analysis of a fuller version of (29).

(31) Inés will come=chá, Inés will not come=chá.[8]

[7] This follows the spirit of van Fintel and Gillies, even though they argue that reasoning does not implicate weakness whereas here, I argue, reasoning does not implicate logical strength.
[8] As Faller doesn‘t offer more details about the scenario, I make up plausible reasons for *ϕ* and ¬*ϕ*.

a. $KK^c(w)_1$ = { ‘If there is a party, Inés often comes’}, $K^c(w) = Ø$

b. $KK^c(w)_2$ = { ‘Inés often has other projects going on’}, $K^c(w) = Ø$

c. $\mathbf{KK^c(w)_{1/2}}$ do not logically entail ϕ or $\neg\phi$.

d. Many ($\lambda w'$.STEREO$^c{}_w(w') \wedge \cap KK_1(w')$; $\lambda w'$.Inés-will-come(w’))
Many ($\lambda w'$.STEREO$^c{}_w(w') \wedge \cap KK_2(w')$; $\lambda w'$.Inés-will-not-come(w’))

Like in §4. we use domain restriction to draw inferences from *many*-frequency statements. We thus can infer ϕ from $KK_1(w')$ and $\neg\phi$ from $KK_2(w')$. (31d) can thus be paraphrased as follows: “Evidence $\mathbf{KK_1}$ suggests that Ines will come, but evidence $\mathbf{KK_2}$ suggests that Ines will not come.” We thus predict that (29) is a ‘maybe yes, maybe not’ reply, which is adequate. Before moving on, a disclaimer should be added. Faller (p.c.) observes that *p=chá, non-p=chá* utterances in her data are *not* restricted to contexts where the speaker consciously weighs one reason against another. (29) is a conventionalized way to say ‘maybe yes, maybe not’, giving rise to the puzzle why the same particle *chá* can be used in stronger assertions elsewhere.[9]

The morpheme =*chá* is not the only inferential in this language. Faller (2002: 174ff) contrasts the evidential morphemes =*chu hina* and =*chá* in Cuzco Quechua. *Chu hina* is used for propositions *p* that rest (even vaguely) on direct evidence, whereas =*chá* is often based on general knowledge (e.g., what I heard, what I vaguely remember, it typically happens that ...). She paraphrases the use-conditional content of *chá* follows: ‘-*chá*: ev= speaker bases a statement on his or her own reasoning’. The intuition that *reasoning* of some kind is involved is echoed by other work on =*chá.* The point is reconfirmed in (Faller, 2011: 664): “Cuzco Quechua has two inferential enclitics [=*chá* and =*chu-sina*], which correspond to a cross-linguistically common distinction between Inference from Reasoning and Inference from Results”. The present framework has the potential to capture the inferential evidentials in Cuzco Quechua in a common framework. The common theme of all is the intuition that the speaker’s knowledge or observations support claim ϕ. Two aspects in context will help the addressee to infer the intended logical strength of assertion ϕ. The first aspect concerns the speaker’s knowledge $\mathbf{KK^c(\mathit{w})}$. Often the addressee has partial information about the speaker’s knowledge $\mathbf{KK^c(\mathit{w})}$ and can estimate the reliability of an update of the common ground with ϕ. E.g., if both interlocutors saw someone come into the building with a wet raincoat, the addressee has reason to interpret (28) as a reliable inference. If, on the other hand, nothing in the context suggests that the speaker has specific knowledge, the addressee is cautioned that the claim may not stand up to scrutiny. The *ϕ=chá and non-ϕ=chá* use signals that the speaker’s knowledge base does not settle the issue. The second aspect is the speaker’s subjective decision whether she wants to label the assertion as ‘securely inferred’ or ‘defeasibly inferred’.

[9] There may be reasons for this conventionalization. Particularly interesting would be field data where speakers openly admit ignorance: *Will Inéz come to the party? — I don’t know.* ‘I don’t know’ and ‘Maybe yes, maybe no’ are almost synonymous answers. Yet, admitting ignorance is a face-threatening move and the use of $\mathbf{KK^c(\mathit{w})_1}$ and $\mathbf{KK^c(\mathit{w})_2}$ offers a strategy to say “I don’t know” in an indirect way.

Sometimes only one choice is possible, but many contexts allow either of two markers and the choice is thus a matter of the speaker's temperament.

6. Summary and outlook

The paper proposes a general framework to model inferential evidentials and capture the intuition that an assertion is justified by 'inferences from own knowledge'. Von Fintel and Gillies (2010) identify this as the central element of epistemic *must* in English, which they model in terms of a set of privileged knowledge, the *kernel* $K^c(w)$. In a first step, I argued that inferences often rest not only on (privileged) direct evidence of the speaker but also on general world knowledge, an aspect that was neglected in the earlier account. The resulting analysis in terms of *kernels with general knowledge* $KK^c(w)$ can still capture all logically strong uses of *must* by von Fintel and Gillies, but can also host the intuition that in some contexts, *must* ϕ signals that the speaker has reservations against plainly asserting ϕ.

German allows a comparison of the markers *muss* ('must') and *wohl*. The IEM *muss* matches English *must* and the particle *wohl* is an IEM that marks ϕ as a defeasible inference from the speaker's knowledge. While assertions with the IEM *muss* can be weak, depending on the scenario, assertions with the IEM *wohl* are always weak. The two markers also differ in use-conditional content: A speaker who utters '*muss* ϕ' is prepared to argue the case, whereas '*wohl* ϕ' signals that the speaker will retract the claim if there is evidence to the contrary. The exact delineations remain to be explored.

Gitksan =*ima* and Cuzco Quechua =*chá* were likewise described in the literature as "presenting propositions ϕ as inferred from the speaker's knowledge". Example scenarios in published fieldwork include the factors we know for *must* and *wohl:* witnessed facts, additional world knowledge, plausible inference and acknowledged circumstances where the inference may be plausible but wrong. Yet, these IEMs can also be used in a weaker sense, as presenting a mere possibility (=*ima*) and/or presenting both ϕ and $\neg\phi$ as possible options (=*chá*). This can be captured by allowing for knowledge sets $KK^c(w)$ that include *frequently*-premises, and are thus weaker than generic statements. Other reported utterance situations suggest that the speaker has two alternative sets of knowledge that suggest conflicting inferences ϕ and $\neg\phi$. (In such cases, the inference must be defeasible, because speaker knowledge is consistent, i.e. cannot logically entail ϕ and $\neg\phi$.) Assertions with these IEMs are logically on a par with possibility statements in English or German. However, a simple translation of =*ima* ϕ to *possibly* ϕ misses out on the point that the speaker justifies the possibility ϕ as being inferred* in a weak sense from what the speaker knows.

Obviously, standard semantic accounts of defeasible inference and generic entailment use ingredients that could, alternatively, be recruited for a modal analysis of IEMs. It is even likely – and maybe a good thing – that analyses in terms of 'inferences' and analyses in terms of modality are provably mathematically equivalent. This, however, doesn't mean that phrasing the account in terms of *inferring* is superfluous. I follow von Fintel and Gillies in spirit, who stress that the logical strength of *must* ϕ is independent of the underlying intuition that inferences have been drawn. The present approach offers a uniform model of *inferring* that can cover IEMs in many languages, independent of their testable logical properties.

Many empirical questions remain. A particularly promising direction for future research are comparisons of different evidential markers in the same language. Faller reports on Cuzco Quechua =*chá* and =*chu-sina* as conjectural (CON) and inference-from-result (RES) markers (Faller 2011:663).

(32) Para-mu-sha-n =chá/ =chu-sina.
rain-CISL-PROG-3 =CONJ/ =RES
p=‘It is raining.’

Faller glosses these as “(CON) Conjectural: =*chá*”, as opposed to “=*chu-sina/=(chu)-suna*: (RES) = Partial evidence/ inference from results; s infers from available evidence that it is raining.” However, she also states that “[t]he Conjectural =*chá* can be used for inferences from a set of premises (…)” (p. 664). This mismatch deserves closer investigation. In the same line, Peterson (2008) describes two Gitksan markers that both rest on inference: =*n*’*akw* (‚the speaker has visible evidence for ϕ‘) as opposed to =*ima* (‚the speaker infers that ϕ‘). Crucially, examples of ‚visible evidence‘ look very much like the witnessed facts in the *must*-examples in (5), (6). This means that =*n’kaw* is not a direct evidential. What else is it? — While classic typologies of evidentials don’t easily host two different inferential evidentials, the present account can capture and distinguish different IEMs in the same language. It allows for meaningful comparisons, see the German evidentials *muss* and *wohl* above. An account of inferential evidential markers that keeps the concept of inferencing distinct from the logical properties of a marker will, therefore, be useful in more than one respect.

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