Today I learned: English 'coming-to-know' predicates

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1 Introduction

- Agenda for today: English 'coming-to-know' predicates, aka 'semi-factives'

(1) *discover*, *find out*, *figure out*, *learn*, *notice*, *realize* ...

- Previous work: puzzles on presupposition projection (Degen and Tonhauser 2022; Djärv 2019, 2023; Karttunen 1971, 2016)
- Our goal: new outlook on the 'coming-to-know' verbs as a natural class
  - Aspectually: culmination achievements
  - Evidentially: specific constraints on how knowledge is grounded
  - Ontologically: change of doxastic state from agnosticism to belief
- In focus: verbs from (1) as exemplars, only declarative *that*-complements (putting aside DP complementation and question embedding, see Djärv (2023) for some interesting connections)
- Proposal: semantic decomposition via a complex eventuality of knowledge acquisition

2 Core data

2.1 Aspect

- Well-known: *notice*, *realize* as textbook achievements
- Less known: the entire class exhibits standard properties (Dowty 1979; Rothstein 2004)
  - Telicity: felicity with *in*-adverbials (2a)
  - Non-durativity: infelicity with aspectual verbs *stop/finish* (2b)

(2) a. ✓In a day, Emma discovered/found out/figured out/learned/noticed/realized that Frank was coming to Highbury.

b. #Emma stopped discovering/finding out/figuring out/learning/noticing/realizing that Frank was coming to Highbury.

- New data: imminency reading of the progressive (4)

- Achievements & the progressive:
  - Typically not compatible with the progressive in the 'ongoing process' interpretation (due to non-durativity; Dowty 1979; Vendler 1957)
  - Sometimes compatible with the progressive with other interpretations (see Gyarmathy 2015 for an overview)
- The imminency reading (Bach 1986; Gyarmathy 2015; Kearns 2003; Piñón 1997 a.o.)
  - Hallmark of culmination achievements: those with a preliminary/preparatory process
  - Paraphrased as 'on the verge of X': the process is in final stages, but hasn't culminated yet
  - Gives rise to the imperfective paradox (is Xing $\not\rightarrow$ has Xed)

(3) a. Rebecca was reaching the summit when it began to rain.
b. Astrid was winning the race when we arrived. (Gyarmathy 2015:23)

- The imminency reading with our verbs (NB: often singular subjects, not an iterative reading)[1]

(4) a. Putin is discovering that overwhelming military power can be a curse. (*The Washington Post*)
b. [Bondaroff] was figuring out that he had the option of becoming, in effect, a corporate muse. (*The New York Times*)
c. You tapped every surface you found in front of you. [...] You were finding out that everything made a sound. (*The New Yorker*)
d. We were learning that sometimes the only way to endure suffering is to transform it into art. (Suleika Jaouad, *Between Two Kingdoms: A Memoir of a Life Interrupted*)
e. Wittgenstein is noticing that the very existence of any limit already suggests another side. (Zach Weber, *Paradoxes and Inconsistent Mathematics*)
f. Murdoch is realizing that he's stuck with the monster he created. (*The Washington Post*)

- Bottom line:
  - our verbs: associated with a process
  - our claim: the process is that of gaining knowledge

- More support for the process component: *beginning to* (bad with standard culminations)

(5) a. Ms. Coppel was beginning to notice that the grand kitchens of Las Vegas were shrinking in size and range.
b. I was beginning to realize that success in skating had a lot more to do with psychological stability or the ability to conquer fear. (*The New York Times*)

1. Some of them have other readings with the progressive, as noted already by Dowty (1979), but even the recent literature does not make reference to the ones we are after, and Gyarmathy (2015) explicitly classifies some of our verbs as achievements of a different type. We suspect it has to do with complement types: people have mostly looked at object DPs.

2.2 Volition

- Well-known: our verbs encode a mental state of the attitude holder (hence the term cognitive/doxastic factives)
- New data: divide based on felicity with intention verbs
  - fine: *discover*, *find out*, *figure out*, *learn* (usually only as question-embedders, an issue we put aside)
  - out: *notice*, *realize*

(6) In the Stanford Prison experiment, Zimbardo intended / was trying to ✓discover / ✓figure out / ✓find out / ✓learn / # notice / / # realize how quickly people conformed to the roles of guard and prisoner.

- Intention verbs *try, intend* (Grano 2011, 2017):
  - encode an agent's realistic expectation to bring about an action
  - select for complements that denote such actions

- Bottom line:
  - our verbs: sensitive to volitionality
  - our claim: the contrast is due to the nature of mental state by a given predicate

- The contrast may be indicative of the differences in argument structure, but we will not go down that route

2.3 Evidence

- Philosophical literature: knowledge requires justification (Lackey 2007; Williamson 2000)
- Linguistic literature: factivity requires acquaintance (Djärv 2019, 2023; Kratzer 2002; Özyildiz 2021)
- New data: justification
  - factives at large: no restrictions on how knowledge of the complement was acquired (to wit, *know* is good in all scenarios below)
  - our verbs: very specific requirements, akin to those found with evidentials (construed very broadly)

- *Notice*:
  - knowledge grounded in perceptual—including interoceptive—experience (7)
  - incompatible with inference (10,11,13,14) or or hearsay (12)
  - resembles 'direct' evidentials (e.g., in Tibetan (Kalsang et al. 2013) or Korean (Lee 2013))

(7) **Visual perception**
Context: Seeing rain outside the window:
Jane ✓discovered / # figured out / ✓found out / ✓learned / ✓noticed / # realized that it was raining.

(8) **Totality of perception**: *notice p* requires that *p* be grounded only in the information acquired via perception alone
Context: Looking at a full moon:
I noticed that the moon was brighter than any planet would have been.

▶ *Notice* + volitionality

— perception is *typically* unconscious (Prinz 2010)
— this explains the infelicity under intention verbs (6)
— lack of volitionality is not lexicalized: felicitous in contexts that bring attention to the subconscious (9)

(9) *Context: Recommendations on body mindfulness:*
Start with external body parts and work your way in . . . trying to notice how that body part feels. After getting comfortable noticing external body parts, then use a slow shift towards noticing the inside body parts.
(https://www.kelly-mahler.com/what-is-interoception/interoception-and-mindfulness/)

▶ *Discover*, *find out*, *learn*

— best described as requiring evidence that is causally upstream of the belief it produces (idea from Cariani (2022) on future-past asymmetries)
— felicitous with perception (4c; 7), abductive inference (10, 11), hearsay (12)
— incompatible with non-abductive inferences (13,14)

(10) **Abduction: reasoning from effect to cause**
Context: Going down to the basement, seeing a rat scurrying away:
I ✓discovered / ✓figured out / ✓found out / ✓learned / # noticed/ ✓realized that we have rats.
inference: one rat indicative of an entire rat problem.

(11) *Context: We're trying to find a way to hike on Crete using public transit. We see that there is a bus from Chania to Chora Sfakion. We know that there is only one road in that direction, so that bus must go by Imbros.*
We ✓discovered / ✓figured out / ✓found out / ✓learned / # noticed/ ✓realized that there is a bus to Imbros.

(12) **Hearsay**
Context: At school, your son attends a talk on the devastating effects of extreme heat in Greece:
He ✓discovered / # figured out / ✓found out / ✓learned / # noticed / ✓realized that Greece was burning.

- *Figure out*
  - — inferential knowledge across the board (10,11 13, 14)
  - — incompatible with perception (7) or hearsay (12)

(13) **Anti-abduction: reasoning based on general knowledge**
Context: Venice banned cruise ship passengers from disembarking on weekdays. Today is a Monday. Boarding a train in Verona, you claim:
I # discovered / ✓figured out / # found out / # learned / # noticed/ ✓realized that there'd be no crowds today. (context adapted from Korotkova 2023)

(14) **Anti-abduction: Eliminative reasoning**
Context: You cannot find your car keys. You have looked everywhere in your house that you have been known to find them, and they are nowhere to be found. You've decided the last place they could be is in your car. Standing in your living room, you claim the following.
I # discovered / ✓figured out / # found out / # learned / # noticed/ ✓realized that the keys are still in the car. (context from Krawczyk 2012)

- *Realize*
  - — requires unconscious reasoning, mental process associated, e.g., with intuition (Johnson-Laird 2008); we will treat it as a cognitive primitive
  - — compatible with various types of inference (10,11,12,13,14)
  - — difference from *figure out*: an aha moment that is not a result of an intentional mental process, which in turn explains its infelicity under intention verbs (6)

- Bottom line
  - — our verbs: constraints as to how knowledge was acquired
  - — our claim: these constraints signal the presence an underlying evidential structure

3 Proposal

- Crux of the analysis: aspect as a window on the event structure of knowledge acquisition
- Assumptions about culmination achievements, such as *reach the summit* (following vast literature on aspect, see overview in Gyarmathy 2015)
  - — assert the punctual event of culmination, e.g., the moment of reaching the summit
  - — presuppose a *cover event*: occurrences of other events that led to the culmination, including the preliminary process diagnosed by the imminency reading of the progressive, e.g., everything that led to reaching the summit
- Assumptions about factivity: cognitive factives presuppose speaker's belief

- Central claim:
  - — all our verbs presuppose a complex eventuality of knowledge acquisition (the cover event)
  - — key evidence: imminency reading of the progressive (4), diagnoses a preliminary process
  - — *notice*, *realize*: the process is not conscious
- Knowledge acquisition, deconstructed
  - (a) initial state of agnosticism, followed by
  - (b) event of evidence acquisition[2], which triggers
  - (c) process of deliberation, which culminates in
  - (d) punctual event of belief-change, which leads to
  - (e) new belief state
- 'Coming-to-know' blueprint

(15) $[\![$ come-to-know $]\!] = \lambda p.\lambda x.\lambda e.\lambda w$:

a. Presupposes:
factivity (simplified) $[\ Pr_{S_{p,w,t_@}}(p) = 1\ ]$, **speaker endorses** p
where Pr is a subjective probability measure that we use as a stand-in for belief,

cover event that includes an an individual x and proposition p
$\wedge\ \exists e_{\text{COV}}[\text{COVER}(e_{\text{COV}}, w, p, x)]$,
where $\text{COVER}(e_{\text{COV}}, w, p, x)$ iff
$[\ e_{\text{COV}} = e_{\text{ACQ}} + e_{\text{DELIB}}$ **events of evidence acquisition and deliberation**
$\wedge\ \neg\text{SETTLED}(x, p, w, \tau(e_{\text{ACQ}} + e_{\text{DELIB}}))$ **initial agnosticism**
$\wedge\ \exists q.\exists t' \prec \tau(e_{\text{ACQ}})[\ Pr_{x,w,t'}(q) < 1\ \wedge\ Pr_{x,w,\tau(e_{\text{ACQ}})}(q) = 1\ ]$ **acquiring new knowledge** q
$\wedge\ Pr_{x,w,\tau(e_{\text{ACQ}})}(p|q) > Pr_{x,w,\tau(e_{\text{ACQ}})}(p|\neg q)$ x **considers** q **evidence for** p
$\wedge\ [\ \forall e', e'' \sqsubseteq e_{\text{DELIB}}[\ \tau(e') < \tau(e'') \rightarrow Pr_{x,w,\tau(e')}(p) < Pr_{x,w,\tau(e'')}(p)\ ]$ **towards settledness**
$\quad \vee\ \forall e', e'' \sqsubseteq e_{\text{DELIB}}[\ \tau(e') < \tau(e'') \rightarrow Pr_{x,w,\tau(e')}(\neg p) < Pr_{x,w,\tau(e'')}(\neg p)\ ]\ ]$,
$\wedge\ \forall e'[\text{CUL}(e', e_{\text{COV},w} \rightarrow \text{SETTLED}(x, p, w, \tau(e'))\ ]\ ]$, **settledness at culmination**

where $\text{SETTLED}(x, p, w, t) \leftrightarrow [\ Pr(x, p, w, t) = 1\ \vee\ Pr(x, p, w, t) = 0\ ]$, CUL is a culmination point (Moens and Steedman 1988).

b. Asserts: **belief-change**
$\overline{\text{CUL}(e, \iota e_1[\text{COVER}(e_1, w, p, x)], w)}\ \wedge\ \forall t' \geq \tau(e)[Pr_{x,w,t'}(p) = 1]$. **culmination in belief**

- Caveats:
  - — our treatment of evidence in terms of subjective probability (cf. Krawczyk 2012; McCready 2015) is a placeholder; each verb lexicalizes a more specific evidential relation;
  - — we sidestep the issue of causality; it will be needed for a full account given that our verbs denote a change of state, though not of the type typically discussed (*break*, *flatten*);
  - — for simplicity, we suppress scales of change associated with culimination achievements; cf. also (Fleisher 2023; Zuchewicz 2020) specifically on factives.

2. The event of evidence acquisition is adapted from literature on evidentiality (see overviews in Hirayama and Matthewson 2022; Johnson 2022). That literature often collapses the distinction between 'acquiring evidence' and 'belief-change', even though conceptually those are distinct, which is what our analysis spells out.

4 Outlook

- Main take-home message: 'coming-to-know' verbs encode a complex eventuality of knowledge acquisition
  - Cover event: property of culmination achievements at large
  - Some aspects of the proposal: rooted in the evidential nature of our verbs
- Key distinctions between our verbs
  - volition
  - types of evidence
- Some other distinctions (not formalized for now)
  - *discover* often conveys something unexpected and noteworthy (cf. Meyer 1997), likely sensitivity to the presence of a salient QUD
  - *find out* and *learn* are most natural with systematic inquiry (*discover* has this use in academic discourse)
- An interesting lexical gap
  - At least in English: no vanilla 'coming-to-know' verb
  - Is the gap accidental? Cross-linguistic research might be revealing
- Overarching issues
  - Fine-grained semantics of attitudes
  - Evidence in language
- Fine-grained semantics of attitudes
  - Much recent research elaborating on standard Hintikkan semantics for attitudes
  - We have shown that our verbs call for lexical decomposition in particular based on aspect (cf. Özyildiz 2021)
- Evidence in language: our verbs fit squarely into a syntactically heterogeneous group of evidentials expressions in English (list from Bary and Korotkova 2023)

(a) epistemic modal auxiliaries, e.g., *must* (von Fintel and Gillies 2010, 2021; Lassiter 2016);
(b) futurate markers, e.g., *will* (Cariani 2021; Winans 2016);
(c) temporal adverbials with *by* phrases, e.g., *by now* (Altshuler and Michaelis 2020);
(d) questions with contextual bias (Büring and Gunlogson 2000; Sudo 2013);
(e) parenthetical constructions (Rooryck 2001; Simons 2007);
(f) perception predicates, e.g., *hear* and *see* (Toivonen 2011; Whitt 2011);
(g) appearance claims, e.g., *looks red* (Rudolph 2020, 2023);
(h) copy raising constructions, e.g., *seems like* (Asudeh and Toivonen 2012);
(i) predicates of personal taste, e.g., *delicious* (Anand and Korotkova 2018; Ninan 2014);
(j) subjective attitudes, e.g., *find* (Kennedy and Willer 2022; Korotkova and Anand 2021).

- Old question: what is the difference between knowledge and belief?
  - — Factivity does not play a role in our analysis
  - — Could we apply our template for 'coming-to-believe' verbs: *conclude*, *infer*, *gather* ...
  - — Those have a typological parallel in the category of revelative (Adelaar 2013; Martínez Vera 2022)
- A very general issue: how much mileage can we get out of our knowledge-acquisition eventuality? Could we argue that all evidentials make reference to a structure like this?

References

Adelaar, W. (2013). A Quechua mirative? In A. Storch and A. Y. Aikhenvald (Eds.), *Perception and Cognition in Language and Culture*, pp. 95–109. Leiden: Brill.

Altshuler, D. and L. A. Michaelis (2020). By now: Change of state, epistemic modality and evidential inference. *Journal of Linguistics 56*(3), 515–539.

Anand, P. and N. Korotkova (2018). Acquaintance content and obviation. In U. Sauerland and S. Solt (Eds.), *Sinn und Bedeutung 22*, Berlin, pp. 161–173. ZAS.

Asudeh, A. and I. Toivonen (2012). Copy raising and perception. *Natural Language and Linguistic Theory 30*(2), 321–380.

Bach, E. (1986). The algebra of events. *Linguistics and Philosophy 9*, 5–16.

Bary, C. and N. Korotkova (2023). Expressing evidence. *Journal of Pragmatics 218*, 1–5.

Büring, D. and C. Gunlogson (2000). Aren't positive and negative polar questions the same? Ms. UCSC/UCLA.

Cariani, F. (2021). *The Modal Future: A Theory of Future-Directed Thought and Talk*. Cambridge: Cambridge University Press.

Cariani, F. (2022). Future-past asymmetries, evidential grounding, and projection. pp. 62–68.

Degen, J. and J. Tonhauser (2022). Are there factive predicates? An empirical investigation. *Language 98*(3), 552–591.

Djärv, K. (2019). *Factive and assertive attitude reports*. Ph. D. thesis, University of Pennsylvania.

Djärv, K. (2023). Knowing and believing things: What DP-complements can tell us about the argument structure and composition of (factive) attitudes. *Journal of Semantics 40*(2), 1–55.

Dowty, D. R. (1979). *Word Meaning and Montague Grammar*. Dordrecht: D. Reidel.

von Fintel, K. and A. S. Gillies (2010). Must ...stay ...strong! *Natural Language Semantics 18*(4), 351–383.

von Fintel, K. and A. S. Gillies (2021). Still going strong. *Natural Language Semantics 29*, 91–113.

Fleisher, N. (2023). Semifactives in comparatives. Poster presented at *SALT 33*.

Grano, T. (2011). Mental action and event structure in the semantics of *try*. In N. Ashton, A. Chereches, and D. Lutz (Eds.), *Semantics and Linguistic Theory 21*, pp. 426–443. Linguistic Society of America.

Grano, T. (2017). Logic of intention reports. *Journal of Semantics 34*, 587–632.

Gyarmathy, Z. (2015). *Achievements, Durativity and Scales*. Ph. D. thesis, University of Düsseldorf.

Hintikka, J. (1962). *Knowledge and Belief*. Cornell University Press.

Hirayama, Y. and L. Matthewson (2022). Evidential-temporal interactions do not (always) come for free. *Journal of Pragmatics 193*, 173–188.

Johnson, K. (2022). Time and evidence in the graded tense system of Mvskoke (Creek). *Natural Language Semantics 30*(2), 155–183.

Johnson-Laird, P. (2008). *How We Reason*. Oxford: Oxford University Press.

Kalsang, J. Garfield, M. Speas, and J. de Villiers (2013). Direct evidentials, case, tense and aspect in Tibetan: Evidence for a general theory of the semantics of evidential. *Natural Language and Linguistic Theory 31*(2), 517–561.

Karttunen, L. (1971). Some observations on factivity. *Papers in Linguistics 4*(1), 55–69.

Karttunen, L. (2016). Presupposition: What went wrong? In M. Moroney, C.-R. Little, J. Collard, and D. Burgdorf (Eds.), *Semantics and Linguistic Theory 26*, pp. 705–731.

Kearns, K. (2003). Durative achievements and individual-level predicates on events. *Linguistics and Philsoophy 26*, 595–635.

Kennedy, C. and M. Willer (2022). Familiarity inferences, subjective attitudes and counterstance contingency: Towards a pragmatic theory of subjective meaning. *Linguistics and Philosophy 45*, 1395–1445.

Korotkova, N. (2023). Conversational dynamics of *razve*-questions in Russian. In M. Onoeva, A. Staňková, and R. Šimík (Eds.), *Sinn und Bedeutung 27*, pp. 328–346. Prague: Charles University.

Korotkova, N. and P. Anand (2021). *Find*, *must* and conflicting evidence. In P. G. Grosz, L. Martí, H. Pearson, Y. Sudo, and S. Zobel (Eds.), *Proceedings of Sinn und Bedeutung 25*, pp. 515–532.

Kratzer, A. (2002). Facts: Particulars or information units? *Linguistics and Philosophy 25*, 655–670.

Krawczyk, E. A. (2012). *Inferred Propositions and the Expression of the Evidence Relation in Natural Language. Evidentiality in Central Alaskan Yup'ik Eskimo and English*. Ph. D. thesis, Georgetown University.

Lackey, J. (2007). Norms of assertion. *Noûs 41*(4), 594–626.

Lassiter, D. (2016). *Must*, knowledge and (in)directness. *Natural Language Semantics 24*(2), 117–163.

Lee, J. (2013). Temporal constraints on the meaning of evidentiality. *Natural Language Semantics 21*(1), 1–41.

Martínez Vera, G. (2022). Tense markers and indirect evidentiality in Quechua and Aymara. In S. S. Lee and Y. Song (Eds.), *SULA 11: Proceedings of the Eleventh Biennial Meeting of the Semantics of Under-Represented Languages in the Americas*, pp. 299–313. University of Massachusetts, Amherst: GLSA.

McCready, E. (2015). *Reliability in Pragmatics*. Oxford: Oxford University Press.

Meyer, P. G. (1997). *Coming To Know: Studies in the Lexical Semantics and Pragmatics of Academic English*. Tübingen: Günter Narr.

Moens, M. and M. Steedman (1988). Temporal ontology and temporal reference. *Computational Linguistics 14*(2), 15–28.

Ninan, D. (2014). Taste predicates and the acquaintance inference. In T. Snider, S. D'Antonio, and M. Weigand (Eds.), *Semantics and Linguistic Theory 24*, pp. 290–309. LS.

Özyildiz, D. (2021). *The Event Structure of Attitudes*. Ph. D. thesis, University of Massachusetts, Amherst.

Piñón, C. (1997). Achievements in event semantics. In A. Lawson (Ed.), *Semantics and Linguistic Theory 7*, Ithaca, NY, pp. 276–293. Cornell university.

Prinz, J. J. (2010). When is perception conscious? In B. Nanay (Ed.), *Perceiving the World*.

Rooryck, J. (2001). Evidentiality, part I. *Glot International 5*(4), 125–133.

Rothstein, S. (2004). *Structuring events: A study in the semantics of lexical aspect*. Wiley-Blackwell.

Rudolph, R. E. (2020). Talking about appearances: The roles of evaluation and experience in disagreement. *Philosophical Studies 177*(1), 197–217.

Rudolph, R. E. (2023). Acquaintance and evidence in appearance language. *Linguistics and Philosophy 46*(1/2), 1–29.

Simons, M. (2007). Observations on embedding verbs, evidentiality, and presupposition. *Lingua 117*(6), 1034–1056.

Sudo, Y. (2013). Biased polar questions in English and Japanese. In D. Gutzmann and H.-M. Gärtner (Eds.), *Beyond Expressives: Explorations in Use-Conditional Meaning*, pp. 275–295. Leiden: Brill.

Toivonen, I. (2011). Perception verbs, copy raising and evidentiality in swedish and english. In *Modular Design of Grammar*. Oxford: Oxford University Press.

Vendler, Z. (1957). Verbs and times. *Philosophical Review 56*, 143–160.

Whitt, R. J. (2011). Subjectivity and evidential perception verbs in english and german. *Journal of Pragmatics 43*(1), 347–360.

Williamson, T. (2000). *Knowledge and Its Limits*. Oxford: Oxford University Press.

Winans, L. (2016). *Inferences of "will"*. Ph. D. thesis, University of California, Los Angeles.

Zuchewicz, K. (2020). *On the Veridicality of Perfective Clause-embedding Verbs in Polish: A Unified Aspect-based Analysis of Incremental Theme Verbs With Nominal and Propositional Complements*. Ph. D. thesis, Humboldt University, Berlin.