

Toward a unified account of Japanese evidential *youda*: a Causal Bayesian approach

Teruyuki Mizuno (UConn) Muyi Yang (UConn)
 teruyuki.mizuno@uconn.edu muyi.yang@uconn.edu

Gist. This study explores a Japanese evidential marker *youda*. There is a general agreement that *p-youda* states that a certain relation holds between the prejacent *p* and some piece of evidence *e*. The discussion concerns two issues: what the relationship is, and what the theoretical status of the evidence is. Building on previous works but also novel data and arguments, we argue that *p-youda* (i) is true only if *p* is a weak necessity epistemic modal and (ii) presupposes that (i) is supported by upward causal inference from *e*.

Introduction. McCready & Ogata (2007) (=M&O) observed the importance of the inference from evidence *e* to prejacent *p*, and proposed truth conditions that require *e* to raise *p*'s probability to a value greater than 0.5 but less than 1. This accounts for examples like (1): the speaker infers that it rained upon observing the wet street. Davis & Hara (2014) and Hara (2017) (=D&H) observed that M&O's account doesn't capture the infelicity of (2). Based on (1) vs. (2), (D&H) argued that *youda* encodes inference that proceeds exclusively *upwards* in asymmetric causal structures (cf. Pearl 2000), and proposed that *p* in *p-youda* be a causal ancestor of *e*. For the causal relation $\boxed{\text{Rained?}} \Rightarrow \boxed{\text{Dry?}}$, the contexts in (1) and (2) instantiate upward (i.e. from 'not dry' to 'rained') and downward (i.e. from 'rained' to 'not dry') inference respectively.

- | | |
|--|---|
| (1) (Looking at the wet street)
<i>ame-ga futta youda.</i>
rain-NOM fell YOUDA
'It seems that it rained.' | (2) (Looking at falling raindrops)
<i>#michi-ga nureta youda.</i>
street-NOM got.wet YOUDA
'It seems that the street got wet.' |
|--|---|

Issue 1: Commitment? It remains controversial whether speakers epistemically commit toward *p* when uttering *p-youda*. M&O's probabilistic condition admits such commitment. For (D&H), the only target of speakers' epistemic commitment is to the causal relation between *p* and *e*; they define the epistemic commitment to *p* as a cancellable implicature based on the observed felicity of '[It rained]-*youda*, but in fact it didn't'. We propose to resolve this apparent disagreement by highlighting a bifurcation of the data whose relevance to the debate neither side has appreciated. The descriptive literature reports that *youda* has two different uses, i.e. the **inferential** ('*suiryoo*') use and the **similitudinal** ('*hikyoo*') use (e.g. Sugimura 2000). The separation of the two uses directly corresponds to the distribution of adverbs that express different types of reasoning. *Douyara* ('apparently') highlights inferential reasoning based on objective evidence and signals the inferential use of *youda*. It can also modify epistemic modals like *nitigainai* ('be absolutely certain') and *kamosirenai* ('might'). *Marude* ('as if') marks the irrealis status of the prejacent, similarly to the subjunctive in languages that use verbal mood in these cases. It signals the similitudinal use but resists other epistemic modals. Importantly, as shown in (3) and (4), while *p-youda* allows the cancellation of *p* when accompanied by *marude*, it doesn't when accompanied by *douyara*. In other words, the speaker does epistemically commit to *p* under the inferential use, but not under the similitudinal use. We claim that M&O and (D&H) were right about one subset of data, but wrong in making unrestricted claims about all uses of *youda*. We mainly discuss the inferential use but come back to the similitudinal use in the last section.

- | | |
|---|---|
| (3) <i>douyara ame-ga futta {youda/ nitigainai/ kamosirenai} kedo, #zissaiwa futtenai</i>
apparently rain-NOM rained YOUDA be.ceratin might but in.fact not.raining
'Apparently it seems/must be/might be that it rained, but in fact it didn't.' | (4) <i>marude ame-ga futta {youda/ #nitigainai/ #kamosirenai} kedo, zissaiwa futtenai</i>
as.if rain-NOM fell YOUDA be.ceratin might but in.fact not.raining
'It looks as if it had rained, but in fact it didn't.' |
|---|---|

Issue 2: Force and Probability. We propose that *youda* is a weak necessity epistemic modal, in line with Lassiter's (2016) *must*. Compared with M&O's probabilistic range for *p*, our *youda* requires *e* to raise *p*'s probability *above a certain high-probability threshold*. For (5), for instance, a weak necessity account of *youda* captures the fact that the speaker needs to engage in reiterated trials until the resultant distribution convinces her that *p* is highly probable. In contrast, M&O would wrongly predict the use of *youda* to be felicitous even in (i) because $P(\text{CoinB}|\text{Head}) = P(H|B)P(B)/P(H) = 0.7 \times 0.5/0.6 = 0.5833... > 0.5$.

- (5) Coin A is a fair coin, and Coin B is biased with 70% chance of head and 30% chance of tail. One of the two coins was randomly picked and flipped n times. ($P(A) = P(B) = .5$, $P(H|A) = .5$, $P(H|B) = .7$)

	Scenario	tosses	heads	Prob. for CoinB	Felicity
CoinB-wo <i>tukatta youda.</i>	(i)	1	1	.5833...	#
CoinB-ACC used YOUDA	(ii)	10	7	.6948...	??
'It seems that they used Coin B.'	(iii)	100	69	.9993...	OK

We also argue that *youda* favors a probabilistic account over (D&H)'s purely causality-centred analysis. This is evidenced by our observation that (1) becomes infelicitous if, say, the speaker lives in a desert where rain is extremely rare under normal circumstances. The rarity of rain rules out *youda* because the probability of p cannot reach the required threshold, although upward reasoning from wet streets to rain would still be salient. This shows that the prior (= the pre-updated probability of p) also affects the felicity of *youda*.

Issue 3: Correlation. We point out that the relation between p and e encoded by *youda* is not restricted to the causal parent-child one argued by (D&H). Consider thunder and rain, which are not causally dominated by each other: they should rather be identified as *correlated events*. Assume a region where rain occurs much more frequently than thunder, and rain without thunder often occurs while thunder without rain is very rare. Probabilistically, observing thunder raises one's expectation towards rain in the current context, whereas observing rain doesn't. This contrast is reflected in the (in)felicity of (6) and (7).

- (6) (Hearing the sound of thunder) (7) (Looking at falling raindrops)
Sorosoro ame-ga fur-u youda. *#Sorosoro kaminari-ga nar-u youda.*
soon rain-NOM fall-PRES YOUDA soon thunder-NOM sound-PRES YOUDA
'It seems that it will rain soon.' 'It seems that it will thunder soon.'

The semantics. Our semantics for *youda* is built on a Causal Bayesian Network model (Pearl 2000). We adopt for the core part of the truth condition Lassiter's (2016) probabilistic formulation of English *must*: p -*youda* is true if the posterior probability of p given e surpasses a context-dependent high probability threshold θ . As with *must p*, p -*youda* is undefined if it is based on direct evidence. In modelling correlation in (6)-(7) within a causal network, we adopt Reichenbach's (1956) common-cause principle that two correlated events always share a *third variable causing both*. We thereby guarantee that inference by *youda* always goes upwards in causal flow: the update with a causal sister first raises the probability of the common cause, and then it triggers indirect epistemic repercussions downwards on the other side. The restriction on causal reasoning is thus incorporated as presupposition that p be the cause or a causal sister of e .

Illustrations. Consider (1) in the desert context discussed in Issue 2. Assume a model in which $\boxed{R} \Rightarrow \boxed{D}$, $\theta = .97$, $P(r) = .001$, $P(\neg d) = .01$ and $P(\neg d|r) = .99$. Calculating the posterior of r updated by $\neg d$, $P(r|\neg d) = P(\neg d|r)P(r)/P(\neg d) = .99 \times .001/.01 = .099 < \theta$. Our semantics thus correctly predicts that the use of *youda* in this context is infelicitous despite the speaker's high credence towards the causal relation. Next consider (6) and (7). Let $\boxed{R} \Leftarrow \boxed{X} \Rightarrow \boxed{T}$ be the causal model in which X , a certain climate factor, is the common cause of R ('Rain?') and T ('Thunder?'). Assume that $\theta = .97$, $P(x) = .099$, $P(r|x) = P(t|x) = .99$, $P(r|\neg x) = .224$, $P(t|\neg x) = .002$. Now, $P(r,t) = P(x,r,t) + P(\neg x,r,t) = P(x)P(r|x)P(t|x) + P(\neg x)P(r|\neg x)P(t|\neg x) = .0974$. Also, $P(r) = P(r|x)P(x) + P(r|\neg x)P(\neg x) = .2998$ and $P(t) = P(t|x)P(x) + P(t|\neg x)P(\neg x) = .0998$. Thus, $P(r|t) = P(r,t)/P(t) = .0974/.0998 = .9759 > \theta$, but $P(t|r) = P(r,t)/P(r) = .0974/.2998 = .3248 < \theta$. This explains the asymmetry in felicity between (6) and (7).

Discussions. We also observe that the causal/probabilistic asymmetries observed in (1)-(2) and (6)-(7) hold with the similitudinal use as well: using *marude* in each sentence does not alter the judgments made for the inferential use. We take this fact as showing that the upward reasoning presupposition and the high probability requirement underlie these different uses as *youda*'s core semantics. Toward a unified account, we discuss how to incorporate the similitudinal use into our semantics.

Selected Refs. Davis&Hara. 2014. 'Evidentiality as a causal relation'. *EISS10*. • Hara. 2017. 'Causality and Evidentiality'. *Amsterdam Colloquium 21*. • Lassiter. 2016. 'Must, knowledge, and (in) directness'. *NLS24*. • McCready&Ogata. 2007. 'Evidentiality, modality and probability'. *L&P30*. • Sugimura. 2000. *Gendai nihongo-ni okeru gaizensei-o arawasu hukusi-no kenkyuu*. Nagoya U Dissertation.