Decomposing Japanese *-kamo*: A Compositional Analysis of Epistemic Possibility and Scalar Ignorance

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1. The puzzle

- The Japanese expression *-kamo wakara-nai* ('KA MO know-NEG') has two interpretations, as shown in (1).

  (1) *taroo-ga tookyoo-ni iru ka mo wakara nai*
  Taro-NOM Tokyo-LOC be KA MO know NEG

  a. **Epistemic Possibility Interpretation**:
  'Taro might be in Tokyo.'

  b. **Scalar Ignorance Interpretation**:
  'I don't know even whether Taro is in Tokyo (and I should).'

  Disambiguation by context:

  – Context for the epistemic possibility interpretation

  (2) a. *taroo-wa tookyoo-ni i-nai-yo-ne*
  Taro-TOP Tokyo-LOC be-NEG-SFP-SFP
  'Taro isn't in Tokyo, is he?'

  b. *iya taroo-wa tookyoo-ni iru ka mo wakara nai-yo*
  no Taro-TOP Tokyo-LOC be KA MO know NEG-SFP
  'No, Taro might be in Tokyo.'

  – Context for the scalar ignorance interpretation

  (3) a. *taroo-ga tookyoo-ni iru-ka-wa wakat-teiru-yo-ne*
  Taro-NOM Tokyo-LOC be-Q-TOP know-PROG-SFP-SFP
  'You know at least whether Taro is in Tokyo, don't you?'

  b. *iya taroo-ga tookyoo-ni iru ka mo wakara nai-yo*
  no Taro-NOM Tokyo-LOC be KA MO know NEG-SFP
  'No, I don't know even whether Taro is in Tokyo (and I should).'

  – These two interpretations look unrelated.
  ⇝ How are these two interpretations derived compositionally?

- **Proposal**:
  – The expression *-kamo* can be decomposed into the question particle *-ka* and the scalar particle *-mo*.
  – The two interpretations follow from a distinction in syntactic structure.

2. Difference in syntactic structure

- Observation 1: One can insert a clear intonational pause or a filler between *-ka* and *-mo* under the scalar ignorance interpretation, but not under the epistemic possibility interpretation.

(4) *taroo-ga tookyoo-ni iru ka {uuun/...} mo wakara nai*
Taro-NOM Tokyo-LOC be KA {FILL/(pause)} MO know NEG

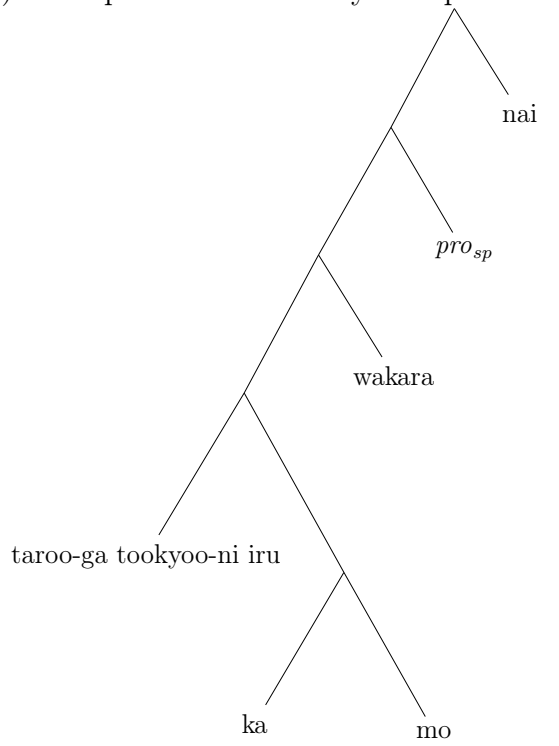
a. * 'Taro might be in Tokyo.' (Epistemic Possibility)

b. 'I don't know even whether Taro is in Tokyo.' (Scalar Ignorance)

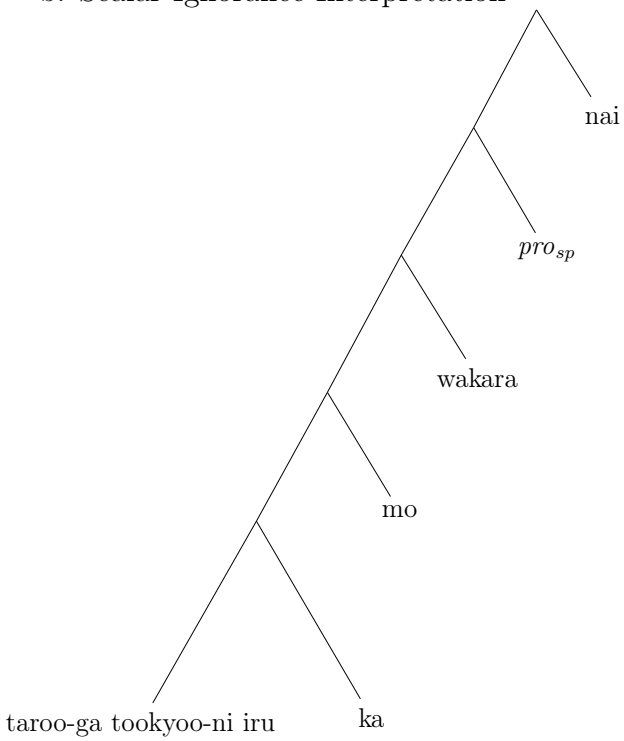
⇒ *-ka* and *-mo* form a single constituent under the epistemic possibility interpretation, while they do not under the scalar ignorance interpretation.

▷ The two interpretations arise from the two different structures in (5).

(5) a. Epistemic Possibility Interpretation



b. Scalar Ignorance Interpretation



- Observation 2: Although the epistemic possibility interpretation seems idiomatic, and thus not compositionally derivable, know-NEG is not idiomatic in either interpretation.
  - *Yoku* ('well') cannot modify a verb in an idiomatic chunk.

(6) a. *Doo-shi-yoo-mo-nai* ('hopeless')
*taroo-wa {∅/*yoku} doo-shi-yoo-mo-nai*
Taro-TOP {∅/well} how-do-way-ADD-NEG
'Taro is hopeless.'

b. *Ha-ga-tata-nai* ('too tough')
*kono mondai-wa ha-ga {∅/*yoku} tata-nai*
this problem-TOP teeth-NOM {∅/well} stand-NEG
'This problem is too tough.'

– *Yoku* can modify *kamo wakara-nai* ('KA MO know-NEG') in either interpretation.

(7) *taroo-ga tookyoo-ni iru ka mo* ***yoku*** *wakara nai*
Taro-NOM Tokyo-LOC be KA MO **well** know NEG
a. 'Taro may well be in Tokyo.' (Epistemic Possibility, $\neg > yoku$)
b. 'I don't know well even whether Taro is in Tokyo (and I should).'
(Scalar Ignorance, $\neg > yoku$)

⇒ Neither interpretation is idiomatic.
⇒ They can be obtained compositionally.

3. Semantic properties of each particle

3.1. Alternative semantics

- Our analysis is based on Alternative Semantics (Hamblin, 1973), where the meaning of a sentence is a set of propositions.
  - $[\![\text{Taro ran}]\!] = \{\lambda w.ran(Taro)(w)\}$
  - $[\![\text{Did Taro run?}]\!] = \{\lambda w.ran(Taro)(w), \lambda w.\neg ran(Taro)(w)\}$
  - $[\![\text{Who ran?}]\!] = \{\lambda w.ran(a)(w), \lambda w.ran(b)(w), \lambda w.ran(c)(w), \dots\}$
- The denotation of each constituent of a sentence is also a set:
  - $[\![\text{Taro}]\!] = \{Taro\}$
  - $[\![\text{ran}]\!] = \{\lambda x.\lambda w.ran(x)(w)\}$
  - $[\![\text{who}]\!] = \{a, b, c, \dots\}$
- Pointwise functional application: When A is the node denoting $\{\alpha_{\sigma\tau}, \alpha'_{\sigma\tau}, \dots\}$ and B is the node denoting $\{\beta_\sigma, \beta'_\sigma, \dots\}$, then C, whose daughters are A and B, has the denotation $\{\alpha(\beta), \alpha(\beta'), \dots, \alpha'(\beta), \alpha'(\beta'), \dots\}$
  - $[\![\text{Taro ran}]\!] = \{(\lambda x.\lambda w.ran(x)(w))(Taro)\} = \{\lambda w.ran(Taro)(w)\}$
  - $[\![\text{who ran}]\!] = \{(\lambda x.\lambda w.ran(x)(w))(a), (\lambda x.\lambda w.ran(x)(w))(b), (\lambda x.\lambda w.ran(x)(w))(c), \dots\}$
    $= \{\lambda w.ran(a)(w), \lambda w.ran(b)(w), \lambda w.ran(c)(w), \dots\}$

3.2. KA

- The Japanese particle *-ka* (the KA particle) functions as a disjunction particle, an existential quantifier, and a question particle.

(8) a. *taroo-ka hanako-ga arui-ta*
Taro-KA Hanako-NOM walk-PAST
'Taro or Hanako walked.' (Disjunction)

b. *dare-ka arui-ta*
who-KA walk-PAST
'Somebody walked.' (Existential quantifier)

c. *taroo-ga arui-ta-ka (shitteiru)*
Taro-NOM walk-PAST-KA (know)
'(I know) whether Taro walked.' (Question)

- Since *-kamo* takes only clauses and does not connect multiple clauses, we can safely assume that *-ka* in *-kamo* functions as a question particle.
- Based on Uegaki (2018); Uegaki & Roelofsen (2018), the denotation of *-ka* can be given as in (9a)[1], using the conditional $\langle ? \rangle$ operator in (9b) (Roelofsen & Farkas, 2015) extended to inputs of arbitrary type.

(9) a. $[\![\text{-}ka]\!] = \lambda\alpha_{\tau t}.\langle ? \rangle\alpha$, where τ is an arbitrary type.

b. $\langle ? \rangle\alpha := \begin{cases} \alpha \cup \{\lambda w.\neg p(w) : p \in \alpha\} & \text{if } \alpha \text{ is of type } \langle st,t\rangle \text{ and } |\alpha| = 1 \\ \alpha & \text{if } \alpha \text{ is of type } \langle st,t\rangle \text{ and } |\alpha| > 1 \\ \lambda\beta.\langle ? \rangle \texttt{PFA}(\alpha,\beta) & \text{otherwise} \end{cases}$

where $\texttt{PFA}(\alpha\beta)$ expresses the pointwise functional application of α and β.

  - When the input α is a declarative sentence that represents a proposition p, α-*ka* denotes the polar question $\{p, \neg p\}$.
  - If α is not of type $\langle st,t\rangle$ at an intermediate stage of the derivation, the $\langle ? \rangle$ operator is left unreduced and carried over to the next step as in the third line of (9b).

3.3. MO

- The particle *-mo* is also multifunctional: it can be a conjunction particle, a universal quantifier, and an additive/scalar particle like *even*.

(10) a. *taroo-mo hanako-mo arui-ta*
Taro-MO Hanako-MO walk-PAST
'Taro and Hanako walked.' (Conjunction)

b. *dare-mo-ga arui-ta*
who-MO-NOM walk-PAST
'Everyone walked.' (Universal quantification)

c. *taroo-mo arui-ta*
Taro-MO walk-PAST
'Taro walked too.' / 'Even Taro walked.' (Additivity/Scalarity)

- Following Nakanishi (2006), we analyze *-mo* as a scalar particle[2] like *even*, as in (11).

(11) a. $[\![\text{-}mo]\!] = \{\lambda p_{st}\lambda w_s.[unlikely(p)(w)].p(w)\}$,
where $[\psi].\varphi$ means that φ presupposes ψ.

b. $unlikely(p)(w) := \forall q \in Alt(p).q \neq p \rightarrow q >_{likelihood,w} p$

- Building on the analysis of *even* as a function over a single proposition (Guerzoni, 2003, 2004), we further assume that scalar *-mo* combines only with a singleton.

(12) Singleton restriction on scalar *-mo*: *-mo* applies only if its propositional argument is a singleton set; otherwise, the composition is undefined.

- Note that the input for *-ka* can be any type of the form τt, where τ is an arbitrary type, while the input for *-mo* is limited to type st.

[1] Uegaki (2018) proposed a unified analysis of the three functions of *-ka*; for simplicity, we adopt the form (9a) applicable only to questions (Uegaki & Roelofsen, 2018). (9a) is compatible with the unified analysis when *-ka* takes a clause, so the denotation of *-ka* can easily be generalized without changing the result.

[2] Nakanishi (2006) assumes that focus *-mo* is lexically distinct from universal *-mo*.

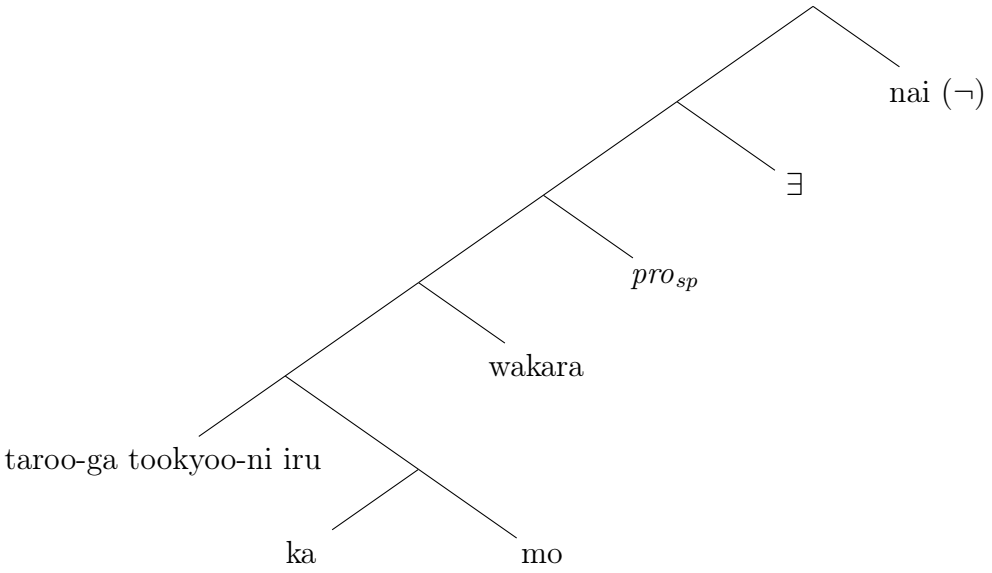
4. Analysis

- Plugging the meanings of the particles into the two syntactic structures results in distinct compositional outcomes, thereby deriving the difference in interpretation.
- Further assumptions about composition
  - Negation and predicates apply only to at-issue content (i.e., only φ in $[\psi].\varphi$).
  - Covert existential closure $\exists$ (Alonso-Ovalle, 2006)

(13) $\exists\alpha_{\langle st,t\rangle} := \{\lambda w.\exists p_{st} \in \alpha.p(w)\}$.
Indeed, $\exists\{\lambda w.\varphi(w), \lambda w.\psi(w)\} = \{\lambda w.\varphi(w) \vee \psi(w)\}$.

4.1. Epistemic Possibility Interpretation

(14) Structure for the Epistemic Possibility interpretation



Composition

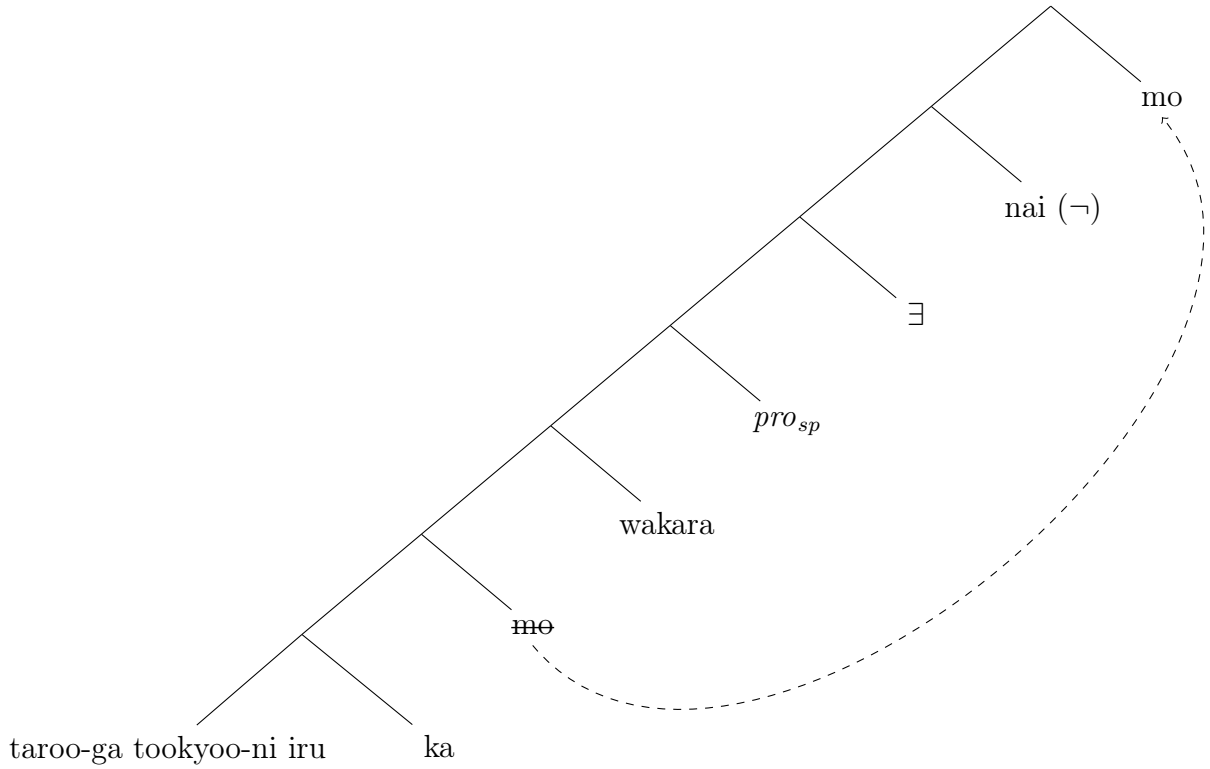
(15) a. $[\![taroo\text{-}ga\ tookyoo\text{-}ni\ iru]\!] = \{\lambda w.p(w)\}$
b. $[\![\text{-}ka\ \text{-}mo]\!] = \langle ?\rangle\{\lambda p\lambda w.[unlikely(p)(w)].p(w)\}$ (applying (9a) to (11))
c. (15a)+(15b) $= \langle ?\rangle\{\lambda w.[unlikely(p)(w)].p(w)\}$
$= \{\lambda w.[unlikely(p)(w)].p(w), \lambda w.[unlikely(p)(w)].\neg p(w)\}$
d. $[\![wakara]\!] = \{\lambda q\lambda x\lambda w.know(x)(q)(w)\}$
e. ((15c)+$[\![wakara]\!]$) + $[\![pro_{sp}]\!]$
$= \{\lambda w.[unlikely(p)(w)].know(sp)(p)(w),$
$\lambda w.[unlikely(p)(w)].know(sp)(\neg p)(w)\}$
f. (15e)+∃ $= \{\lambda w.[unlikely(p)(w)].(know(sp)(p)(w) \vee know(sp)(\neg p)(w))\}$
g. $[\![(14)]\!]$ = (15f)+¬
$= \{\lambda w.[unlikely(p)(w)].\neg(know(sp)(p)(w) \vee know(sp)(\neg p)(w))\}$
$= \{\lambda w.[unlikely(p)(w)].(\neg know(sp)(p)(w) \wedge \neg know(sp)(\neg p)(w))\}$

- (15g) means that the speaker does not know either p or $\neg p$, presupposing that p is the least likely proposition to be true, which captures the epistemic possibility interpretation.

4.2. Scalar Ignorance Interpretation

- Structure: the particle *-mo* covertly raises to avoid composing with a question, whose denotation has multiple elements.

(16) Structure for the Scalar Ignorance interpretation



Composition

(17) a. $[\![taroo\text{-}ga\ tookyoo\text{-}ni\ iru]\!] = \{\lambda w.p(w)\}$

b. (17a)+$[\![$*-ka*$]\!] = \{\lambda w.p(w), \lambda w.\neg p(w)\}$

c. (17b)+$[\![wakara]\!] + [\![pro_{sp}]\!] = \{\lambda w.know(sp)(p)(w), \lambda w.know(sp)(\neg p)(w)\}$

d. (17c)+$\exists = \{\lambda w.know(sp)(p)(w) \vee know(sp)(\neg p)(w)\}$

e. (17d)+$\neg = \{\lambda w.\neg(know(sp)(p)(w) \vee know(sp)(\neg p)(w))\}$
$= \{\lambda w.\neg know(sp)(p)(w) \wedge \neg know(sp)(\neg p)(w)\}$

f. (17e)+$[\![$*-mo*$]\!] = \{\lambda w.[unlikely(\lambda w'.\neg know(sp)(p)(w') \wedge \neg know(sp)(\neg p)(w'))(w)].$
$(\neg know(sp)(p)(w) \wedge \neg know(sp)(\neg p)(w))\}$

- (17f) successfully captures the scalar ignorance reading via the presupposition that the speaker should know whether p or $\neg p$.

5. Remaining issues

- The Japanese verb *shiru* also means *know* and can take a *-kamo* clause as its complement:

(18) a. *taroo-ga tookyoo-ni iru ka mo shir-e nai*
Taro-NOM Tokyo-LOC be KA MO know-able NEG
'Taro might be in Tokyo' (unambiguously)

b. *taroo-ga tookyoo-ni iru ka mo shira nai*
Taro-NOM Tokyo-LOC be KA MO know NEG
'I don't know even whether Taro is in Tokyo' (unambiguously)

  - (18a), with the potential suffix *-e*, has only the epistemic possibility interpretation, while (18b), which lacks it, has only the scalar ignorance interpretation.
  - We believe this lack of ambiguity can be accounted for by appealing to the difference between *wakaru* and *shiru* (Mizumoto, 2018, 2021; Farese, 2018).

- NPIs such as *sukoshimo* and *kesshite* ('at all') can co-occur with *kamo wakara-nai* ('KA MO know-NEG') under the scalar ignorance but not the epistemic possibility interpretation.

(19) *taroo-ga tookyoo-ni iru ka mo* ***kesshite/sukoshimo*** *wakara nai*
Taro-NOM Tokyo-LOC be KA MO **at all** know NEG

a. * 'Taro might be in Tokyo.'

b. 'I don't know even whether Taro is in Tokyo.'

  - Possible explanation: the presupposition of the epistemic possibility interpretation, but not the scalar ignorance interpretation, conflicts with the semantic content of NPIs.
    - These two NPIs, at least, add the implication that the speaker does not know *anything* about the embedded sentence.
    - The epistemic possibility interpretation presupposes that the embedded sentence is unlikely to be true, which is incompatible with knowing nothing about it.
    - On the other hand, the scalar ignorance interpretation does not presuppose anything about the likelihood of the embedded sentence itself, but rather about the lack of knowledge. Thus, there is no conflict and NPIs are still licensed.

6. Conclusion

- We have proposed a unified compositional analysis of the two readings of *-kamo* by decomposing it into the question particle and the scalar particle.
  - The two readings arise from composing the question particle *-ka* and the scalar particle *-mo*, according to two distinct syntactic structures.
  - Although some previous work has noted the apparent morphosyntactic complexity of Japanese *-kamo* as *-ka* and *-mo* (cf. McCready, 2005; Kaufmann & Tamura, 2020), to our knowledge, no compositional analysis has been proposed.
  - This work offers independent and novel support for the analysis of *-ka* in Uegaki (2018).
- This paper contributes to:
  - the wider discussion of Japanese modality expressions (Hara, 2006; McCready & Ogata, 2007; Uegaki & Roelofsen, 2018; Kaufmann & Tamura, 2020, a.o.);

- the literature on differing syntactic parses leading to distinct semantics;
- cross-linguistic work on the decomposition of modal expressions (von Fintel & Iatridou, 2007; Vander Klok & Hohaus, 2020).

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