

Thinking Statively and Dynamically: A View from Georgian

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Abstract

Whether verbs like *think* can embed questions depends on lexical aspect (Özyıldız 2021; Özyıldız 2024): stative ‘think’ is compatible only with declarative complements, whereas process ‘think’ can combine with both declaratives and interrogatives. In this paper we provide a refinement to this generalization based on the data from Georgian, and propose an account of why such dependence between lexical aspect and embeddability of questions holds. We propose that both stative and process ‘think’ are derived from a more abstract common core—the former via a genericity operator (Özyıldız 2024), the latter via a cumulativity operator—and argue that the genericity operator leads to interpreting ‘think’ as ‘believe’ with declaratives, but gives rise to a semantically deviant meaning with interrogatives.

1 The Puzzle

Although verbs like *think* have traditionally been assumed to be *anti-rogative* (Grimshaw 1979; Mayr 2019; Theiler, Roelofsen, and Aloni 2019), recent literature reveals a more complex empirical picture (Dayal 2016; White and Rawlins 2018; Özyıldız 2021; Özyıldız 2024; White 2021): the ability of these verbs to embed questions is contingent on their lexical aspect (see also Grohne 2016; Grohne 2017). Özyıldız (2021) proposed the following generalization for English *think*: it can combine with questions only if it is dynamic. In (2a), the interrogative CP is embedded under the verb *think* in the past simple form, which commonly receives a stative interpretation, and the resulting sentence is ungrammatical. In (2b), the present progressive form is used, giving rise to a process interpretation and a grammatical sentence with an embedded question.

- (1) **Özyıldız’s (2021) Generalization about ‘think’**
When ‘think’ composes with a question,
the resulting eventuality description must be dynamic. (Özyıldız 2021, p. 34)
- (2) a. *I thought whether to invite Bill to the party.
b. I’m thinking whether to invite Bill to the party. (Dayal 2016)

Interrogative clauses may receive different interpretations depending on the embedding verb. While the embedded CPs in (3a) and (3b) appear identical, the CP under *ask* must be interpreted as a question (*Q*), and the CP under *tell* is understood as the answer to the question (*ANS-Q*).

- (3) a. Nene **asked** [whether Shota came]. *Q-interrogative*
↪ Nene uttered the question “Did Shota come?”
b. Nene **told** me [whether Shota came]. *ANS-Q-interrogative*
↪ Nene uttered the answer to the question “Did Shota come?”

This distinction raises the question of how to interpret the generalization in (1): are only *Q*-interrogatives subject to the stativity restriction, or are *ANS-Q* interrogatives, which resemble declaratives in having a single proposition as their content, subject to it too?

Georgian (South Caucasian) is another language that obeys Özyıldız’s (2021) generalization: to embed questions, *pikr-ob-s* ‘(s)he thinks’ must be dynamic. In (4)-(5) we see that at least in this language, the stativity ban extends to *ANS-Q* interrogatives. (5) cannot be understood as Keti having a belief whose content is the answer to the question “*Who is the best candidate?*”. But the sentence does allow two process readings: one where Keti is wondering about what the answer is (*Q*), and one where Keti is having a recurring thought that is the answer to the question (*ANS-Q*).

- (4) keti-m i-pikr-a [rom šota sauk’eteso k’andidat’i-a].
 Keti-ERG **pv-think-AOR.3SG** that Shota best candidate-BE.PRS.3SG
Stative: Keti had the belief that Shota is the best candidate.
Process: Keti kept having the thought that Shota is the best candidate.
- (5) keti-m i-pikr-a [tu vin aris sauk’eteso k’andidat’i].
 Keti-ERG **pv-think-AOR.3SG Q who** BE.PRS.3SG best candidate
 **Stative Q*: Keti had the question “Who is the best candidate?”.
 **Stative ANS-Q*: Keti had a belief which was an answer to the embedded question.
Process Q: Keti entertained the question “Who is the best candidate?”.
Process ANS-Q: Keti had a recurring thought that is an answer to the question “Who is the best candidate?”.

The **main goal** of this paper is to derive the refined generalization in (6).

- (6) **Our generalization about ‘think’**
 Interrogative clauses with ‘think’ (both *Q* and *ANS-Q*) are compatible with the process interpretation of the verb but not with the stative one.

Any account of this generalization needs to make an assumption about how the process ‘think’ and the stative ‘think’ are related to one another. We will assume that neither of the readings is the basic one¹: both are derived from a more abstract meaning of the verbal root.

2 Content and Subject Matter of Thinking Situations

We propose that the verbal root $\sqrt{\text{THINK}}$ denotes a predicate of episodic mental states where the cognitive attention is directed to some propositional content:

- (7) $[\sqrt{\text{THINK}}] = \lambda s. \text{mental-state}(s)$

For these states, there are two properties which will be relevant to us—content and subject matter:

- (8) a. **Content of s** ($\text{cont}(s)$) is a set of propositions restricted to the doxastic set of the attitude holder that represents *the content of thinking*.
 b. **Subject Matter of s** ($\text{SM}(s)$) is a partition on the doxastic set of the attitude holder that represents *the topic of thinking*.

Under this approach, *to think* is to entertain propositional content compatible with one’s beliefs. Assuming a neo-Davidsonian event semantics, we will introduce arguments of the $\sqrt{\text{THINK}}$ predicate by separate theta projections; in particular, the content of the thinking situation is introduced by the functional head Θ_{CONT} (cf. Θ_{EXP} for the experiencer):

¹Cf. for example (Krifka et al. 1995; Özyıldız 2024), where stative ‘think’ is derived from dynamic ‘think’ via genericity and (Moens and Steedman 1988), where dynamic verbs are derived from stative ones via coercion.

$$(9) \quad \llbracket \Theta_{\text{CONT}} \rrbracket = \lambda Q_{(st)t}. \lambda s. \text{cont}(s) = \{p \cap \text{dox}_{\text{exp}(s)} \mid p \in Q\} \quad \text{abbr } \text{cont}(s) = Q|_{\text{dox}_{\text{exp}(s)}}$$

The Θ_{CONT} head takes a set of propositions as its first argument. We assume the *uniformity approach* to clausal embedding, according to which both declarative and interrogative clauses denote sets of propositions (Ciardelli and Roelofsen 2015; Theiler 2014; Theiler, Roelofsen, and Aloni 2018, a.o.), and so the head in (9) will be able to compose with both types of clauses; declarative CPs in this case will denote singleton sets. The content of the thinking situation will be a set of propositions obtained by intersecting every proposition in Q with the set of worlds compatible with the beliefs of the experiencer in s ; we abbreviate this as $Q|_{\text{dox}_{\text{exp}(s)}}$. Additionally, we propose that the propositional content of thinking events cannot be empty (10):

$$(10) \quad \text{NON-EMPTINESS OF CONTENT:} \quad \forall s(\text{mental-state}(s) \rightarrow \text{cont}(s) \neq \emptyset)$$

The full denotation of x *thinks* Q is shown in (11): it's true if and only if there is a mental state of x whose content is a set of propositions from Q intersected with the doxastic state of x .

$$(11) \quad \llbracket \Theta_{\text{EXP}} x \text{ think } \Theta_{\text{CONT}} Q \rrbracket = 1 \text{ iff } \exists s[\text{exp}(s) = x \wedge \text{mental-state}(s) \wedge \text{cont}(s) = Q|_{\text{dox}_{\text{exp}(s)}}]$$

Now let us discuss subject matters. We propose the constraint in (12) that relates subject matters to the content of thinking situations in terms of *aboutness* (Lewis 1988b; Lewis 1988a). Given any pair of propositions from $\text{cont}(s)$ and $\text{SM}(s)$, they either have an empty intersection, or the proposition in $\text{SM}(s)$ is a subset of the proposition in $\text{cont}(s)$.

$$(12) \quad \text{CONSTRAINT ON SUBJECT MATTERS: For any thinking situation } s, \text{cont}(s) \propto \text{SM}(s) \text{ where } \text{“}\propto\text{” (‘‘about’’)} \text{ is defined as follows:}$$

$$\forall S_1, S_2 \in D_{st,t} : S_1 \propto S_2 \text{ iff } \forall q \in S_2, \forall p \in S_1 [p \cap q = \emptyset \vee q \subseteq p]$$

Let us illustrate this constraint at work with the following example. Imagine that there is a thinking situation s whose subject matter is *Who came to the party?* This subject matter is a partition of the doxastic state of the attitude holder—for our purposes, we will consider a toy model with only two individuals, Ann and Bill, and thus a 4-cell partition. This $\text{SM}(s)$ is compatible with different **propositional contents**, but they all must stand in the aboutness relation to the **subject matter**. We illustrate this in Figures 1-3. The contents in (13a) and (13b) are possible propositional contents for the subject matter at hand, but (13c) is not.

$$(13) \quad \begin{array}{l} \text{a. } \text{cont}(s) = \{\{s' : \text{Ann came in } s'\} \cap \text{dox}_{\text{exp}(s)}\} \\ \text{b. } \text{cont}(s) = \{\{s' : \text{Ann came in } s'\} \cap \text{dox}_{\text{exp}(s)}, \{s' : \text{Ann didn't come in } s'\} \cap \text{dox}_{\text{exp}(s)}\} \\ \text{c. } \text{cont}(s) = \{\{s' : \text{It's raining in } s'\} \cap \text{dox}_{\text{exp}(s)}\} \end{array}$$

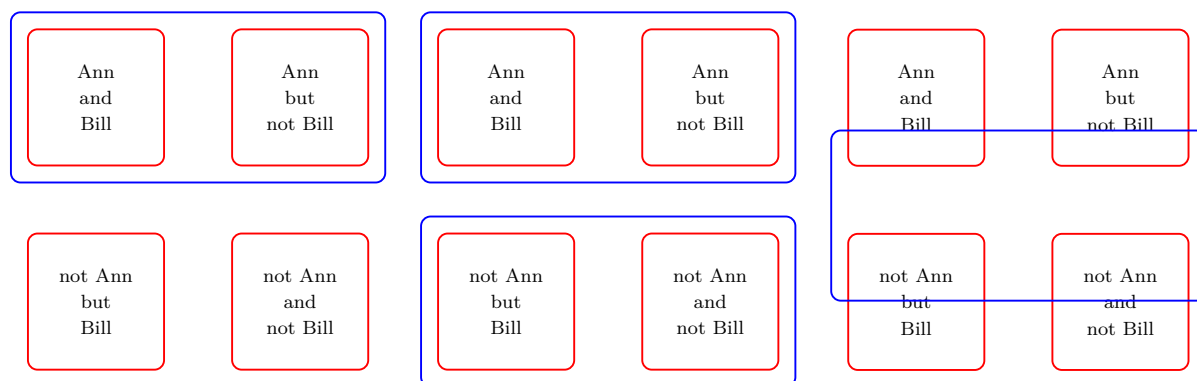


Figure 1: **Ann came to the party** is about **Who came to the party?**

Figure 2: **Did A. come to the party?** is about **Who came to the party?**

Figure 3: **It's raining** is not about **Who came to the party?**

Taking the content *Ann came to the party* in (13a), shown in Fig. 1, we see that $\text{cont}(s) \propto \text{SM}(s)$. This is because the single proposition in $\text{cont}(s)$ makes no further distinctions between equivalence classes in the partition: it is either a superset of the propositions in $\text{SM}(s)$ or has an empty intersection with them, satisfying the definition in (12). The content in (13b), which is the question *Did Ann come?*, is also about the subject matter *Who came?*, as is shown in Fig. 2. Propositions *Ann came* and *Ann didn't come* again make no further distinctions between worlds in the partition of the subject matter. Finally, the content in (13c), which is the proposition *It is raining*, is **not** about the subject matter *Who came?*, as illustrated in Figure 3. The proposition in $\text{cont}(s)$ has a non-empty intersection with all of the propositions in $\text{SM}(s)$, but the latter are not its subsets. In fact, $\text{cont}(s)$ and $\text{SM}(s)$ are **orthogonal**, that is, any two propositions where one is from $\text{cont}(s)$ and the other is from $\text{SM}(s)$ share a non-empty intersection:

$$(14) \quad \text{ORTHOGONALITY: } S \perp S' :\leftrightarrow \forall p \in S \forall q \in S' : p \cap q \neq \emptyset$$

3 Stative ‘Think’

We propose that the stative ‘think’ is derived from the basic meaning in (11) by application of the genericity operator (Chierchia 1995, a.m.o.), which results in the following denotation:

$$(15) \quad \text{Gen } s[C(x)(s)][\exists s' \sqsubseteq s(\text{exp}(s') = x \wedge \text{mental-state}(s') \wedge \text{cont}(s') = Q|_{\text{dox}_x})]$$

In all contextually restricted situations $C(x)$, there is a situation of the experiencer x having a mental state with propositional content Q . What kinds of situations might we find in the restrictor of **Gen**? We suggest that $C(x)$ consists of those situations in worlds maximally similar to ours where the felicity conditions for x having a thought are met and there are no inhibiting factors. We can think of these situations as pluralities of mental states experienced by x at a moment in time. (15) states that in each such plurality, we will be able to find a sub-situation whose propositional content is Q . Once we start considering pluralities of mental states and their parts, we need to make assumptions about how their subject matters are related to one another. Here we will assume the principle in (16): that the subject matter of sub-situations is the same as the subject matter of situations that they are part of.

$$(16) \quad \text{SUBJECT MATTER INHERITANCE:} \\ \forall s(\text{exp}(s) = x \wedge \text{mental-state}(s) \wedge (\exists s' \in C(x) : s \sqsubseteq s') \rightarrow \text{SM}(s) = \text{SM}(s'))$$

Our proposal is that the situations in $C(x)$ are not restricted any further than what we have suggested above: the restrictor will contain absolutely any situation in which the pre-conditions for thinking are met and there are no inhibiting factors. $C(x)$ will thus, we hypothesize, include situations with all kinds of possible subject matters, and we will be able to find at least two (but probably many more) situations with orthogonal subject matters among them. We formulate this hypothesis as *diversity of subject matters* in (17): we will be able to find two situations in $C(x)$ such that each of their cells share a non-empty intersection.

$$(17) \quad \text{DIVERSITY OF SUBJECT MATTERS:} \\ \exists s, s' \in C(x) : \text{SM}(s) \perp \text{SM}(s')$$

Now let us see how our semantics for stative ‘think’ explains its behavior with declarative and interrogative CPs. For the declarative statement x *thinks* p , we will get the meaning in (18).

$$(18) \quad \text{Gen } s[C(x)(s)][\exists s' \sqsubseteq s : \text{exp}(s') = x \wedge \text{mental-state}(s') \wedge \text{cont}(s') = \{p \cap \text{dox}_x\}]$$

Suppose that the logical formula in (18) is true. Then by DIVERSITY OF SUBJECT MATTERS (17), it follows that we will be able to find at least two situations in $C(x)$ with orthogonal subject

matters, say s_1 and s_2 . Both of these situations have a part, let's call them s'_1 and s'_2 respectively, whose shared content is $\{p \cap \text{dox}_x\}$. According to SUBJECT MATTER INHERITANCE (16), the subject matters of s'_1 and s'_2 will be the same as their corresponding bigger situations, and since $\text{SM}(s_1) \perp \text{SM}(s_2)$, they will be orthogonal to each other by extension: $\text{SM}(s'_1) \perp \text{SM}(s'_2)$. Thus, we arrive at the conclusion that if the statement is true, the attitude holder will hold mental states with the same content but of orthogonal subject matters. Given the CONSTRAINT ON SUBJECT MATTERS in (12), this means that the three conditions in (19) must hold simultaneously, which turns out to be possible only in two cases: either $p \cap \text{dox}_x = \text{dox}_x$ or $p \cap \text{dox}_x = \emptyset$.

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|------|---|---|
| (19) | <ul style="list-style-type: none"> a. $\{p \cap \text{dox}_x\} \propto \text{SM}(s'_1)$ b. $\{p \cap \text{dox}_x\} \propto \text{SM}(s'_2)$ c. $\text{SM}(s'_1) \perp \text{SM}(s'_2)$ | <p>THEOREM:</p> <p>the conditions in (19) are all satisfied iff either $p \cap \text{dox}_x = \text{dox}_x$ or $p \cap \text{dox}_x = \emptyset$.</p> |
|------|---|---|

To see why this is the case, let us instead suppose that neither of these two options is true. Then $p \cap \text{dox}_x$ will be a non-empty proper subset of dox_x . From $\{p \cap \text{dox}_x\} \propto \text{SM}(s'_1)$, it follows that $p \cap \text{dox}_x$ is a superset for some of the propositions in $\text{SM}(s'_1)$ and has no overlap with others. Now because $\text{SM}(s'_1) \perp \text{SM}(s'_2)$, it follows that all the propositions in $\text{SM}(s'_1)$ will have non-empty intersections with all the propositions in $\text{SM}(s'_2)$, and thus all the propositions from $\text{SM}(s'_1)$ that $\{p \cap \text{dox}_x\}$ is a superset of will partially overlap with propositions from $\text{SM}(s'_2)$. But this means that $\{p \cap \text{dox}_x\}$ itself will partially overlap with propositions in $\text{SM}(s'_2)$, and so it will not be *about* $\text{SM}(s'_2)$ —the condition in (19b) cannot be satisfied.

Hence we are left with two options: either $p \cap \text{dox}_x = \text{dox}_x$ or $p \cap \text{dox}_x = \emptyset$. The latter, however, cannot be true due to NON-EMPTINESS OF CONTENT (10), so we conclude that $p \cap \text{dox}_x = \text{dox}_x$. But this implies that $\text{dox}_x \subseteq p$; thus, we have shown that for the stative ‘think’ to be true with a declarative clause p , the attitude holder must believe p .

Now let us consider interrogatives with stative ‘think’, which will have the meaning in (20).

- (20) Gen $s[C(x)(s)][\exists s' \sqsubseteq s : \text{exp}(s') = x \wedge \text{mental-state}(s') \wedge \text{cont}(s') = Q|_{\text{dox}_x}]$,
 where $Q|_{\text{dox}_x}$ is a non-trivial partition of dox_x (i.e., has at least two equivalence classes)

Once again, DIVERSITY OF SUBJECT MATTERS, (17), will ensure that at least two situations in $C(x)$ have orthogonal subject matters, and thus by SUBJECT MATTER INHERITANCE, (16), there will be at least two sub-situations with orthogonal subject matters but identical content: the partition of the doxastic state with respect to the question Q . This state of affairs turns out to be impossible—in all such cases, CONSTRAINT ON SUBJECT MATTERS in (12) will be violated. This is because if $Q|_{\text{dox}_{exp}} \propto \text{SM}(s'_1)$ and $\text{SM}(s'_1) \perp \text{SM}(s'_2)$, then the propositions in $\text{SM}(s'_2)$ will necessarily make additional distinctions between the worlds within the cells of the $Q|_{\text{dox}_{exp}}$ partition, and thus it will be necessarily false that $Q|_{\text{dox}_{exp}} \propto \text{SM}(s'_2)$.

The remaining question that we have to explain is why *ANS-Q* interrogatives are incompatible with stative ‘think’ despite the fact that their propositional content is a singleton set. We would like to suggest that in sentences like (21), where the interrogative clause is interpreted as an/the answer to the embedded question, the subject matter of the thinking situation is always equal to the embedded question. Thus, (21) can be paraphrased as “*on the topic of whether Shota came, Nene has an opinion.*” Given that $\text{cont}(s) \propto \text{SM}(s)$, the content of Nene’s thoughts must be one of the two propositions—either *Shota came* or *Shota didn’t come*.

- (21) Nene **is certain** [whether Shota came]. *ANS-Q interrogative*
 \rightsquigarrow *presupposes* $\text{SM}(s) = \{\text{Shota came, Shota didn’t come}\}$

This presupposition is simply incompatible with the generic operator. Consider the meaning that we will get (22): in all of the situations where pre-conditions for thinking are met, there is a sub-situation whose content is an answer to Q , and whose subject matter is Q .

$$(22) \quad \text{Gen } s[C(x)(s)][\exists q \in Q, \exists s' \sqsubseteq s : \\ \text{exp}(s') = x \wedge \text{mental-state}(s') \wedge \text{cont}(s') = \{q \cap \text{dox}_x\} \wedge \text{SM}(s') = Q|_{\text{dox}_x}]$$

SUBJECT MATTER INHERITANCE, (16), and DIVERSITY OF SUBJECT MATTERS, (17), will together require that there be two distinct sub-situations whose content is an answer to Q intersected with dox_x , whose subject matter is $Q|_{\text{dox}_x}$, and whose subject matters are orthogonal. The last two conditions cannot be met at the same time, as no subject matter is orthogonal to itself.

4 Process ‘Think’

For process ‘think,’ a different operator than **Gen** is embedded within the basic meaning from (11). We propose that this dynamic interpretation of *think* involves a sum of mental state events; specifically, they are realized by the **DO** operator in (23).

$$(23) \quad \llbracket \text{DO} \rrbracket = \lambda P_{st}. \lambda s : \exists s', s'' [s' \neq s'' \wedge s = s' \oplus s'' \wedge *P(s') \wedge *P(s'')]. *P(s)$$

This operator captures the **strictly cumulative** meaning of *dynamic eventualities*, taking a predicate of situations/events and returning only those which are strictly non-atomic. When applied to the root predicate from (7), we obtain the following denotation:

$$(24) \quad \llbracket \Theta_{\text{EXP}} x [\text{DO think}] \Theta_{\text{CONT}} Q \rrbracket = 1 \text{ iff} \\ \exists s [\text{exp}(s) = x \wedge \llbracket \text{DO} \rrbracket (\lambda s. \text{mental-state}(s'))(s) \wedge \text{cont}(s) = Q|_{\text{dox}_{\text{exp}(s)}}]$$

To relate the content of these complex thinking situations in (24) to the contents of their subparts, we assume a **homomorphism** from the part structure of events to that of event contents (cf. Bondarenko and Elliott 2024). In this manner, the union of the sub-event contents is equated with the content of the maximal event sum in its mereology.

$$(25) \quad \forall s, s' \in \text{Dom}(\text{cont}) : s \sqsubseteq s' \longrightarrow \text{cont}(s) \subseteq \text{cont}(s')$$

This homomorphism between thinking events and their propositional contents in (25) yields the following predictions: given any situation s whose content is a singleton set, corresponding to a declarative complement p , we have $\text{cont}(s) = \{p \cap \text{dox}_{\text{exp}(s)}\}$ and for any sub-situation $s' \sqsubseteq s$, it must also be the case that $\text{cont}(s') = \{p \cap \text{dox}_{\text{exp}(s)}\}$ by **NON-EMPTYNESS OF CONTENT**, (10). The resultant meaning is thus an **iterative** event of thinking p , which matches the ‘recurring thought’ interpretation of the example from Georgian with process ‘think’ in (4).

For interrogative complements Q , the content of a complex thinking situation s in (24) is a *plural* set of propositions which form a partition of $\text{dox}_{\text{exp}(s)}$, i.e. $\text{cont}(s) = Q|_{\text{dox}_{\text{exp}(s)}}$. By the homomorphism in (25) and **NON-EMPTYNESS OF CONTENT** (10), any sub-situation $s' \sqsubseteq s$ must have as its content some non-empty subset of $Q|_{\text{dox}_{\text{exp}(s)}}$, which may include more than one proposition from the partition. The resultant meaning is thus an event of entertaining different possible answers to Q , which matches the interpretation with process ‘think’ + Q in (5). As for process ‘think’ with **ANS-Q**, the content of s is also a singleton proposition corresponding to an answer to Q , which will therefore reduce to the declarative case and yield an iterative meaning, with the added presupposition that $\text{SM}(s) = Q|_{\text{dox}_{\text{exp}(s)}}$.

5 Conclusion

Consistent with Özyıldız’s (2021) generalization in (1), we confirm that Georgian ‘think’ embeds questions only if it receives a dynamic interpretation — this fact extends both to Q and **ANS-Q** readings for interrogative complements. We propose that ‘think’ starts from a basic meaning, whose stative and process interpretations result from applying different operators, **Gen** and **DO**.

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