Mereology of thoughts,

and why you can't (statively) think a question

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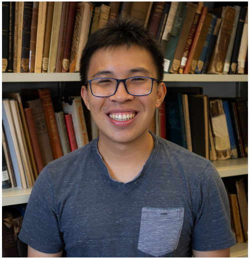
Collaborators

Think embedding questions, in Georgian and beyond



Richard Luo

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Bondarenko, T., Luo, R. and Rouillard, V., 2024. Thinking Statively and Dynamically: A View from Georgian. *Proceedings of the 24th Amsterdam Colloquium*. pp. 44-50.

Introduction

Introduction

Verbs like *think* have traditionally been assumed to be anti-rogative (Grimshaw 1979; Mayr 2019; Theiler et. al 2019).

(1) a. John thought that Bill saw someone.
    b. *John thought who Bill saw.

(Grimshaw, 1979)

Introduction

However, there is accumulating evidence that we're dealing with a more complex empirical picture (Dayal 2016; White and Rawlins 2018; Özyıldız 2021; Özyıldız 2024; White 2021): the ability to embed questions is contingent on **lexical aspect**.

(2) a. *I thought whether to invite Bill to the party.
    b. I'm thinking whether to invite Bill to the party.
    (Dayal 2016)

(3) **Özyıldız's (2021) Generalization about 'think'**
When 'think' composes with a question,
the resulting eventuality description must be dynamic.
(Özyıldız 2021, p. 34)

- Aspectual systems of languages vary, and so are the details of when/how ‘think’ *can* embed questions.
- What seems to be uniform is what ‘think’ *cannot* do:

(4) **Stative ‘think’ Universal**
When ‘think’ is stative, it cannot embed questions.

- **Q:** Why would this universal hold?

Preview of the proposal:

1. At any given time, an attitude holder stands in a having relation to a set of thoughts, which are ordered by a parthood relationship and form a mereological structure.
2. Stative 'think' is a regular generic derived from an episodic 'have-a-thought': it states that *"Whenever the conditions for thinking are met and nothing hinders thinking, the attidue holder has a thought with content P"*.
3. Stative 'think' describes beliefs because beliefs are thoughts you always have.

4. Due to how we'll define parthood of contents, having a thought with inquisitive content implies all thoughts it's part of are inquisitive. Having a declarative thought does not require that all of the sup-thoughts be declarative.

5. <u>Stative 'think' + Q</u> is deviant because it requires the attitude holder to wonder at all times.

6. <u>Stative 'think' + P_{decl}</u> allows the attitude holder to have diverse mental states, and implies that P_{decl} is always part of all of them$\rightsquigarrow$it is a belief.

Roadmap:

1. The Empirical Puzzle
2. Proposal
   - mereological structure of thoughts;
   - mereological structure of thought contents;
   - explaining the **stative 'think'* + *Q* generalization.
3. Open Questions

The Empirical Puzzle

The Empirical Puzzle

(White 2021): numerous attested examples of *think whether*

(5) *[O]ften, when listening to some other players (especially beginners) I start to **think whether** there's an unwritten law for guitarists to never play an interval bigger than the major third.*

(6) *I'm trying to **think whether** I'd have been a star today or not.*

(7) *[...]the righteousness is unbelievable and people[...] will have to **think whether** they want four more years of that.*

(Özyıldız, 2021): also numerous examples of *think* + *wh*

(8) *The audience then isn't* ***thinking who*** *the killer could be, they're only waiting for a previously established character to return, fuck shit up, and say "game over."*

(9) ***Think*** *for a second* ***what*** *other things these police officers could have done instead of firing at least 7 bullets into the back of Jacob Blake Jr. leaving him, at this moment, paralyzed.*

Cross-linguistically stable pattern:

- English;
- Turkish (Özyıldız 2021);
- Georgian (Bondarenko et. al 2024);
- Russian.

The Empirical Puzzle

Interrogative clauses may receive different interpretations depending on the embedding verb:

(10) a. Q-*interrogative*

Nene **asked** [whether Shota came].

$\rightsquigarrow$ Nene uttered <u>the question</u> "Did Shota come?"

b. $\textsc{Ans}$-Q-*interrogative*

Nene **told** me [whether Shota came].

$\rightsquigarrow$ Nene uttered <u>the answer to the question</u> "Did Shota come?"

The Empirical Puzzle

Declarative clauses are compatible with both **stative** and **process** interpretations:

(11) keti-m **i-pikr-a**
Keti-ERG **pv-think-AOR.3SG**
[**rom** šota sauk'eteso k'andidat'i-a].
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.

The Empirical Puzzle

Interrogative clauses occur only with **process** readings:

(12) keti-m **i-pikr-a**
Keti-ERG **pv-think-AOR.3SG**
[**tu vin** aris sauk'eteso k'andidat'i].
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?" *(speaker variation)*

What I will *not* try to solve today:

- Why are stative ANS-Q readings bad?
- Why is there variation across speakers in how acceptable they find process ANS-Q readings?

Hope:
This should fall out of the syntactic distribution of the ANS operator /constraints on its insertion.

The Empirical Puzzle

- Lexical aspect of ‘think’ cross-linguistically is not limited to states and processes.
- E.g., Russian has ‘think’ which is atelic (stative/process):

(13) Maša **dve minuty** /***za dve minuty**
Masha **two minutes** /**in two minutes**
dumala, čto Katja obraduetsja
think.PST.**IPFV** COMP Katya will.be.happy
čerepaxe.
tortoise.DAT
‘Masha thought for two minutes/*in two minutes that Katya will be happy (to get) a tortoise.’

- But it also has two telic verbs formed from the same root *duma* 'think'. First, 'have a thought' verb with prefix *po*-.

(14)

Maša	?**za**	**dve**	**minuty**	/***dve**	**minuty**	
Masha	**in**	**two**	**minutes**	/**two**	**minutes**	
po-dumala,	čto	Katja	obraduetsja			
PFV-think.PST	COMP	Katya	will.be.happy			
čerepaxe.						
tortoise.DAT						

'Masha thought in two minutes /*for two minutes that Katya will be happy (to get) a tortoise.'

The reading: time before Masha had a thought was 2 minutes $\rightarrow$ *achievement*

The Empirical Puzzle

- Second, ‘come up with, invent, decide’ verb with prefix *pri*-.

(15) Maša **za dve minuty** /***dve minuty**
Masha **in two minutes** /**two minutes**
pri-dumala, čto Katja obraduetsja
PFV-think.PST COMP Katya will.be.happy
čerepaxe.
tortoise.DAT
‘Masha thought in two minutes /*for two minutes that Katya will be happy (to get) a tortoise.’

The reading: it took Masha two minutes to decide how things will be → *accomplishment*

- E.g., Masha is a screenplay writer who tries to decide what will happen in the next episode of the show.

What I will *not* try to solve today:

- How do telic readings of ‘think’ arise?
- How do they interact with the embeddability of questions?
- Are interrogative clauses with telic predicates interpreted as Q or $\textsc{Ans}(Q)$?

The Empirical Puzzle

The Empirical Puzzle

Plan for today:

- Take seriously the idea that stative ‘think’ is generic — and a garden-variety one.
- Use that fact to explain why it cannot embed questions.
- Do this by exploring an issue that we need to explore regardless of this puzzle: what are mereological properties of such entities as thoughts and their contents?

Previous approaches that do not appeal to genericity:

- Impossibility of 'think' with questions is related to its neg-raising property (Theiler et. al 2019).
- Follows from a lexical entry that states that the inquisitive state is a subset of the meaning of the embedded sentence P, and that the attitude holder is evaluating propositions in P (Özyıldız 2021);

Previous approaches that appeal to genericity:

- Stative 'think' is a generic *'Whenever the attitude holder is asked whether p, they think p'* (Özyıldız 2024);
- Stative 'think' is a generic, and it cannot embed questions because of how question meanings restrict subject matters (Bondarenko et al. 2024) — '*Whatever the attitude holder thinks about, they think about Q*".

Proposal

Proposal

Assumption: both stative and process readings of ‘think’ are derived from a common (episodic) core meaning.

$$\begin{tikzcd} & \text{basic meaning} \arrow[dl] \arrow[dr] & \\ \text{stative think} & & \text{process think} \end{tikzcd}$$

Alternatives:

- stative ‘think’ $\rightarrow$ process ‘think’ (Moens & Steedman 1988);
- process ‘think’ $\rightarrow$ stative ‘think’ (Krifka et al. 1995; Özyıldız 2024).

Basic Meaning: ‘Have a Thought’

(16) $$[\![x \ \sqrt{\textit{think}} \ P]\!]^s = 1 \text{ iff } \exists t, s' \in s$$
$$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$$

“There is a thought t, and it is had by x, and its content is P”.

Proposal

Stative 'think' = GEN + $\sqrt{think}$

- Following Özyıldız 2024, I assume that there is a genericity operator in the sentences with stative 'think'.
- The GEN is taken as is from (Chierchia 1995).

(17) $[\![\textsc{gen}\ \ x\ \ \sqrt{think}\ \ P]\!]^s = 1$ iff
$\textsc{gen}\ s\ \ [C(s)(x)]\ \ \exists t, s' \in s$
$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$

- "In all contextually restricted situations $C(s)(x)$, there is a thought t with content P that the attitude holder x has."

Proposal

What kinds of situations are in C?

- $C(s)(x)$ contains 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.
- (Chierchia 1995): "Perhaps, the only restriction we want to impose...is that <*the attitude holder*> be part of it.":

(18) $$[\![\textsc{gen}\ \ x\ \ \sqrt{think}\ \ P]\!]^s = 1 \text{ iff}$$
$$\textsc{gen}\ s\ \ [x \sqsubseteq s]\ \ \exists t, s' \in s$$
$$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$$

Proposal

Let's elaborate on what we actually mean by this!

$[\![x \ \sqrt{think} \ \ P]\!]^s = 1$ iff $\exists t, s' \in s$
$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$

- What kinds of things are 'thoughts an attitude holder has'?
- What kinds of things are their contents?
- How are the two related?

Thoughts

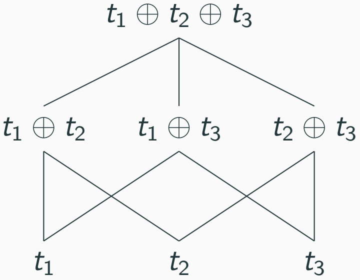
Assumptions about thoughts

- At any given moment τ in situation s, an attitude holder x holds a plurality of thoughts T—thoughts x is having at τ.

(19) $T_{x,s,\tau} :=_{def} \{t \mid \exists s' \in s \text{ at } \tau[\textsc{have}(s')(t)(x)]\}$

- These are not necessarily beliefs! Just thoughts.
- They are ordered by the parthood relationship $\sqsubseteq$, and there is a maximal element in T, which I'll call $\textsc{sum}_T$.

I'll be following an order-theoretic perspective rather than an algebraic one, but in case a visualization is helpful:



- $T_{x,s,\tau} = \{t_1, t_2, t_3, t_1 \oplus t_2, t_1 \oplus t_3, t_2 \oplus t_3, t_1 \oplus t_2 \oplus t_3\}$
- $\mathrm{SUM}_{T_{x,s,\tau}} = t_1 \oplus t_2 \oplus t_3$

Proposal

- I think we can hypothesize the thought-structure to be a **mereology** (Champollion & Krifka 2016):

(20) **Axioms of classical extensional mereology**

a. **Reflexivity:** $\forall x, x \sqsubseteq x$

b. **Transitivity:** $\forall x, y, z, (x \sqsubseteq y \wedge y \sqsubseteq z) \rightarrow x \sqsubseteq z$

c. **Anti-symmetry:** $\forall x, y(x \sqsubseteq y \wedge y \sqsubseteq x) \rightarrow x = y$

(21) **Overlap:** $x \circ y \Leftrightarrow \exists z[z \sqsubseteq x \wedge z \sqsubseteq y]$

(22) **Sum** (Tarksi 1929): $\textsc{sum}$ of a set T is the element s.t. $\forall y[T(y) \rightarrow y \sqsubseteq \textsc{sum}] \wedge \forall z[z \sqsubseteq \textsc{sum} \rightarrow \exists z'[T(z') \wedge z \circ z']]$

Contents of thoughts

Proposal

Assumptions about contents

Following (Kratzer 2006; Anand and Hacquard 2008; Moulton 2009, Bogal-Allbritten 2016, Elliott 2017 a.m.o.):

$\textsc{Cont}$ is a partial function, which, when applied to an individual, returns its content if it has one.

(23) $\textsc{Cont}$ is a partial function from $D_e \to D_{cont}$, where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$ $\forall p, q \in C[p \neq q \to [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

Proposal

(24) $\textsc{Cont}$ is a partial function from $D_e \rightarrow D_{cont}$,
where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$
$\forall p, q \in C[p \neq q \rightarrow [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

(25) **Declarative Content {p}**
x has declarative content if $\textsc{Cont}$(x) is a singleton set

(26) **Inquisitive Content {p, q,...}**
x has inquisitive content if $\textsc{Cont}$(x) is a set containing at least two distinct propositions

Proposal

(27) $\textsc{Cont}$ is a partial function from $D_e \rightarrow D_{cont}$,
where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$
$\forall p, q \in C[p \neq q \rightarrow [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

Inquisitive Content must be a Partition:

- Propositions in C must be incompatible with each other;
- Condition "$p \cup q \notin C$" excludes non-singleton sets containing $\varnothing$ from being in D_{cont}, e.g. $\{p, \varnothing\} \notin D_{cont}$.

Proposal

Abbreviation:
$a = \{w : \text{Ann came in } w\}$, $\neg a = \{w : \text{Ann didn't come in } w\}$,
$b = \{w : \text{Bill came in } w\}$, $\neg b = \{w : \text{Bill didn't come in } w\}$

(28) $[\![\text{that Ann came}]\!] = \lambda x.\textsc{cont}(x) = \{a\}$

(29) $[\![\text{whether Ann came}]\!] = \lambda x.\textsc{cont}(x) = \{a, \neg a\}$

(30) $[\![\text{who came}]\!] = \lambda x.\textsc{cont}(x) = \{ab, a\neg b, \neg ab, \neg a\neg b\}$

Contents of Thoughts

- What is the part-whole structure of contents like?
- How is the part-whole structure of thoughts mapped onto the part-whole structure of their contents?

(Bondarenko & Elliott 2024) explore these questions for declarative content. Here I'll generalize to all content.

Proposal

I'll use something already defined in (Bondarenko & Elliott 2024) as *"Conjunctive Parthood"*, and which takes inspiration in the works by Kit Fine (2017a/b/c):

(31) **Conjunctive Parthood** (def.)
For any $P, Q \in D_{st,t}$, $P \sqsubseteq Q$ iff

$$\forall p \in P \;\; \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \;\; \exists p \in P[q \subseteq p]$$

- **NB:** I will actually use it differently, gaining back the issues related to disjunction & logical omniscience.

Proposal

$$\underline{\forall p \in P\ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q\ \exists p \in P[q \subseteq p]}$$

(32)
a. $\{\lambda w.$ it is raining in $w\}$
$\sqsubseteq \{\lambda w.$ it is raining heavily in $w\}$
b. The thought is that it's raining heavily.
c. $\rightsquigarrow$Part of this thought is that it's raining.

Proposal

$$\underline{\forall p \in P \ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \ \exists p \in P[q \subseteq p]}$$

(33) a. $\{\lambda w.$ it is raining in $w\}$
$\not\sqsubseteq \{\lambda w.$ it is raining in w, $\lambda w.$ it is not raining in $w\}$

b. The question is whether it's raining or not.

c. $\not\rightsquigarrow$Part of this question is that it's raining.

Proposal

$$\underline{\forall p \in P \ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \ \exists p \in P[q \subseteq p]}$$

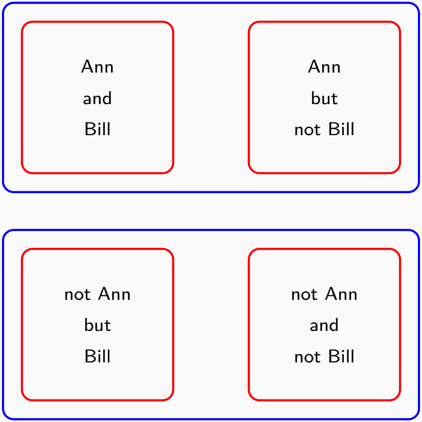
(34) a. $\{\lambda w.$ Ann came in w, $\lambda w.$ Ann didn't come in $w\}$
$\sqsubseteq$
$\{\lambda w.$ Ann and Bill came in w,
$\lambda w.$ Ann didn't come and Bill came in w,
$\lambda w.$ Ann didn't come and Bill didn't come in w,
$\lambda w.$ Ann came and Bill didn't come in $w\}$

b. The question is who came to the party.

c. $\rightsquigarrow$Part of this question is whether Ann came to the party.

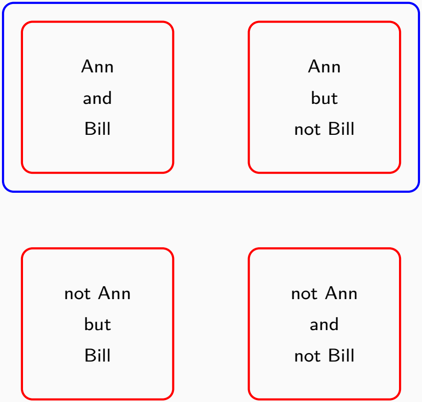
d. $\not\rightsquigarrow$Part of this question is that Ann came to the party.

Proposal



Did Ann come to the party? $\sqsubseteq$ Who came to the party?

Proposal



Ann came to the party $\not\sqsubseteq$ Who came to the party?

Ann came to the party $\sqsubseteq$ Ann and Bill came to the party

Proposal

An alternative (which I couldn't make to work):

take an algebraic perspective (Champollion & Krifka 2016) and define parthood in terms of the summation operation in (35):

(35) **Summation for Contents** (def.)
For any $P, Q \in D_{st,t}$,
$P \oplus Q = \{p \bigcap q \mid p \in P \wedge q \in Q\}$

(36) **Parthood for Contents** (def.)
For any $P, Q \in D_{st,t}$, $P \sqsubseteq Q$ iff
$\exists R \in D_{st,t}[P \oplus R = Q]$

- See (Ciardelli et. al. 2017: sect. 3.1.) for a discussion of the issues that arise with (35).

Proposal

- I will assume that **overlap** and **sum** can be defined for this definition of parthood in a parallel way ($P, Q, R \in D_{cont}$).

(37) **Overlap:** $P \circ Q \Leftrightarrow \exists R[R \sqsubseteq P \wedge R \sqsubseteq Q]$

(38) **Sum** (Tarksi 1929): $\textsc{sum}$ of a set C is the element s.t. $\forall P[C(P) \rightarrow P \sqsubseteq \textsc{sum}] \wedge \forall R[R \sqsubseteq \textsc{sum} \rightarrow \exists R'[C(R') \wedge R \circ R']]$

"a sum of the set of contents C is a thing that consists of everything in C and whose parts each overlap with something in C"

Proposal

- The resulting structure will form a mereology
due to the restrictions we placed on D_{Cont} (!)

(39) $\textsc{Cont}$ is a partial function from $D_e \rightarrow D_{cont}$,
where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$
$\forall p, q \in C[p \neq q \rightarrow [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

- The fact that inquisitive contents are partitions is crucial in ensuring **the anti-symmetry property**.

Proposal

Reflexivity: $\forall P, P \sqsubseteq P$

Imagine this was false. Then this would need to be false:

$\underline{\forall p \in P \;\; \exists q \in P[q \subseteq p]}$

1. $\{\varnothing\} \sqsubseteq \{\varnothing\}$, because $\varnothing$ is a subset of any set.

2. If P contains one or more non-empty propositions:
this cannot be false because $\forall p[p \subseteq p]$.

Proposal

Transitivity: $\forall P, Q, R\,(P \sqsubseteq Q \land Q \sqsubseteq R) \to P \sqsubseteq R$

Imagine this was false. Then this would need to hold:

1.True: $\forall p \in P\ \exists q \in Q[q \subseteq p] \quad \land \quad \forall q \in Q\ \exists p \in P[q \subseteq p]$

2.True: $\forall q \in Q\ \exists r \in R[r \subseteq q] \quad \land \quad \forall r \in R\ \exists q \in Q[r \subseteq q]$

3.False: $\forall p \in P\ \exists r \in R[r \subseteq p] \quad \land \quad \forall r \in R\ \exists p \in P[r \subseteq p]$

The conjunction is false if one of the conjuncts is false.

Proposal

Imagine the first conjunct is false:

1.True: $\forall p \in P \ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \ \exists p \in P[q \subseteq p]$

2.True: $\forall q \in Q \ \exists r \in R[r \subseteq q] \quad \wedge \quad \forall r \in R \ \exists q \in Q[r \subseteq q]$

3. $\underline{\exists p \in P \ \neg\exists r \in R[r \subseteq p]}$

Let's instantiate this $p \in P$ as p_1. Because $P \sqsubseteq Q$, we get that $\exists q \in Q[q \subseteq p_1]$. Let's instantiate it as q_1. Because $Q \sqsubseteq R$, $\exists r \in R[r \subseteq q_1]$. Let's instantiate it as r_1. Due to transitivity of subsethood, we get that $r_1 \subseteq p_1$, arriving at a contradiction.

Proposal

Imagine the second conjunct is false:

1.True: $\forall p \in P \;\exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \;\exists p \in P[q \subseteq p]$

2.True: $\forall q \in Q \;\exists r \in R[r \subseteq q] \quad \wedge \quad \forall r \in R \;\exists q \in Q[r \subseteq q]$

3. $\underline{\exists r \in R \;\neg\exists p \in P[r \subseteq p]}$

Let's instantiate this $r \in R$ as r_1. Because $Q \sqsubseteq R$, we get that $\exists q \in Q[r_1 \subseteq q]$. Let's instantiate it as q_1. Because $P \sqsubseteq Q$, $\exists p \in P[q_1 \subseteq p]$. Let's instantiate it as p_1. Due to transitivity of subsethood, we get that $r_1 \subseteq p_1$, arriving at a contradiction.

Proposal

Anti-symmetry: $\forall P, Q\,(P \sqsubseteq Q \wedge Q \sqsubseteq P) \rightarrow P = Q$

Imagine this was false. Then this would need to hold:

1.True: $\forall p \in P\ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q\ \exists p \in P[q \subseteq p]$

2.True: $\forall q \in Q\ \exists p \in P[p \subseteq q] \quad \wedge \quad \forall p \in P\ \exists q \in Q[p \subseteq q]$

3. $\underline{\exists p[p \in P \wedge p \notin Q]}$

If P and Q are not identical, there must be a proposition that is in one of them but not in the other.

Proposal

1. True: $\forall p \in P \ \exists q \in Q[q \subseteq p] \quad \wedge \quad \forall q \in Q \ \exists p \in P[q \subseteq p]$

2. True: $\forall q \in Q \ \exists p \in P[p \subseteq q] \quad \wedge \quad \forall p \in P \ \exists q \in Q[p \subseteq q]$

3. $\underline{\exists p[p \in P \wedge p \notin Q]}$ *let's instantiate it as p*

Because $P \sqsubseteq Q$, it follows that $\exists q \in Q[q \subseteq p]$. Let's instantiate it as q_1 Because $Q \sqsubseteq P$, it follows that $\exists q \in Q[p \subseteq q]$. Let's instantiate it as q_2. Since by assumption $p \notin Q$, it follows that $p \neq q_1$ and $p \neq q_2$. Thus, we get that $\underline{[q_1 \subset p] \wedge [p \subset q_2]}$, which means that $\underline{q_1 \subset q_2}$.

Proposal

<u>**q1 $\subset$ q2**</u>

<u>1. Imagine $q_1 \neq \varnothing \wedge q_2 \neq \varnothing$.</u>
Due to restrictions on content, we arrive at the contradiction: "$q_1 \cap q_2 = \varnothing$" is incompatible with "$q_1 \cap q_2 = q_1$" if $q_1 \neq \varnothing$.

(40) $\textsc{Cont}$ is a partial function from $D_e \rightarrow D_{cont}$, where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$ $\forall p, q \in C[p \neq q \rightarrow [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

Proposal

$q1 \subset q2$

2. Imagine $q_2 = \varnothing$. Then we get that $p \subset \varnothing$, from which it would follow that $p = \varnothing$. But this then violates our assumption that $p \in P \wedge p \notin Q$.

Proposal

$\mathbf{q1 \subset q2}$

3. Imagine $q_1 = \varnothing$, $q_2 \neq \varnothing$. Then we arrive at a contradiction due to the definition of D_{cont}. If $Q \in D_{cont}$, then for any two distinct propositions in Q it must be the case that their union is not in Q. However, $(q_1 \cup q_2) = (\varnothing \cup q_2) = q_2$, and $q_2 \in Q$.

(41) $\quad$ $\textsc{Cont}$ is a partial function from $D_e \rightarrow D_{cont}$, where $D_{cont} \subset (D_{st,t} - \varnothing)$ s.t. $\forall C \in D_{cont}$ $\forall p, q \in C[p \neq q \rightarrow [p \cap q = \varnothing \wedge p \cup q \notin C]]$.

Thus, there can't be any p such that $p \in P \wedge p \notin Q$.
Anti-symmetry holds!

Flagging a (potentially huge) issue

- We had to sacrifice contents like (42) that introduce alternatives but don't form a partition.
- So we'll need a new account of sentences like (44).

(42) $\{\lambda w.\text{Ann drank coffee in } w, \lambda w.\text{Ann drank tea in } w\}$

(43) $\{\lambda w.\text{Ann drank coffee or tea in } w\}$

(44) I thought that either Ann drank coffee, or she drank tea.

- Adopting (43) reintroduces the issue of logical omniscience that Bondarenko & Elliott (2024) were attempting to solve with Conjunctive Parthood.

A note on contradictory thoughts

- A contradictory thought state can be represented as having content $\{\varnothing\}$.
- Having two thoughts with contradictory contents results in the $\textsc{sum}_C$ being contradictory:

(45)
a. If $\{p\} \sqsubseteq \textsc{sum}_C$, $\forall q \in \textsc{sum}_C[q \subseteq p]$
b. If $\{\neg p\} \sqsubseteq \textsc{sum}_C$, $\forall q \in \textsc{sum}_C[q \subseteq \neg p]$
c. The only way for these to hold at the same time is if $\textsc{sum}_C = \{\varnothing\}$.

Proposal

How are thoughts related to their contents?

- All we'll need for our puzzle is a principle like *Mapping to SuperContents*, which ensures that content of a bigger thought has content of a smaller thought as its part.

(46) *Mapping to SuperContents*
$\forall$ t,t' $\in$ D_e, P' $\in$ D_{cont}:
$\textsc{Cont}$(t') $=$ P' $\wedge t' \sqsubseteq t$
$\rightarrow \exists P[P' \sqsubseteq P \wedge \textsc{Cont}(t) = P]$

- Other mapping principles could be defined too (e.g. see Bondarenko & Elliott 2024).

Why stative ‘think’ cannot embed questions

Proposal

Inquisitive Thought
$\rightsquigarrow$ Inquisitive Sum or a Contradictory State

1. $\exists P \sqsubseteq \textsc{sum}_C[\exists p, p' \in P[p \neq p']]$

2. $\forall p, p' \in P[p \neq p' \rightarrow [p \cap p' = \varnothing \wedge p \cup p' \notin P]]$.

3. $\forall p \in P \exists q \in \textsc{sum}_C[q \subseteq p] \wedge \forall q \in \textsc{sum}_C \exists p \in P[q \subseteq p]$

4. Let us assume that $|\textsc{sum}_C| = 1$, and the unique proposition in $\textsc{sum}_C$ is q. Let's see how this implies a contradictory state. Let us take any two distinct propositions p and p' in P.

Proposal

5. Because $\forall p \in P \exists q \in \textsc{sum}_C[q \subseteq p]$,
it must be true that $q \subseteq p \wedge q \subseteq p'$

6. Because the question-thought P is a partition, $p \cap p' = \varnothing$, and so this can only be true if $q = \varnothing$.

Thus, the only way for inquisitive thought to be part of a declarative sum is if <u>the sum is $\{\varnothing\}$</u>
—*the contradictory thought*.

Proposal

Declarative Thought $\neg\rightsquigarrow$ Declarative Sum

1. $\exists P \sqsubseteq \textsc{sum}_C[|P| = 1]$. Let us assume that $P = \{p\}$.
2. $\forall p \in P \exists q \in \textsc{sum}_C[q \subseteq p] \land \forall q \in \textsc{sum}_C \exists p \in P[q \subseteq p]$
3. $\textsc{sum}_C$ can be inquisitive as long as: $\forall q \in \textsc{sum}_C[q \subseteq p]$

Proposal

For example, we could have a small plurality consisting of just three thoughts t_1, t_2 and the $\textsc{sum}_T$:

- $\textsc{Cont}(t_1) = \{p\}$
- $\textsc{Cont}(t_2) = \{q, \neg q\}$
- $\textsc{Cont}(\textsc{sum}_T) = \textsc{sum}_C = \{p \cap q, p \cap \neg q\}$
- $\{p\} \sqsubseteq \{p \cap q, p \cap \neg q\}$
- $\{q, \neg q\} \sqsubseteq \{p \cap q, p \cap \neg q\}$

Proposal

- Recall that we're considering stative 'think', created by the use of the genericity operator with a very wide restrictor: $C(s)(x)$ will contain all situations which x is part of.

(47) $[\![\textsc{gen}\ \ x\ \ \sqrt{think}\ \ P]\!]^s = 1$ iff
$\textsc{gen}\ s\ \ [C(s)(x)]\ \ \exists t, s' \in s$
$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$

Proposal

- This implies that $C(s)(x)$ will contain both situations with declarative thought sums, including non-contradictory ones, and situations with inquisitive thought sums, (48).

(48) **Diversity of GEN** $\sqrt{think}$

$$\exists s' \in C(s)(x)[|\textsc{cont}(\textsc{sum}_{Tx,s',\tau})| = 1] \wedge$$
$$\exists s' \in C(s)(x)[|\textsc{cont}(\textsc{sum}_{Tx,s',\tau})| > 1],$$

and $\exists s' \in C(s)(x)[|\textsc{cont}(\textsc{sum}_{Tx,s',\tau})| = 1 \wedge \textsc{cont}(\textsc{sum}_{Tx,s',\tau}) \neq \varnothing]$

- Thus, the meaning of GEN $\sqrt{\textit{think}}$ is incompatible with P being inquisitive:

(49) $\{s \mid \exists t, s' \in s[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge |\textsc{Cont}(t)| \geq 1]\} \subset \{s \mid C(s)(x)\}$

is incompatible with

$\{s \mid C(s)(x)\} \subseteq \{s \mid \exists t, s' \in s$ $[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge |\textsc{Cont}(t)| \geq 1]\}$

- Hence, stative ‘think’ is incompatible with questions.

What about the process 'think'?

- No generic quantification $\rightarrow$ compatible with questions.
- We can think of this meaning as arising due to the DO operator, which creates a complex event consisting of multiple having-thought events with content P:

(50) $[\![\text{DO } x \ \sqrt{think} \ P]\!]^s = 1$ iff
$\exists e, e', e'' \in s\, [e' \neq e'' \wedge e' \sqsubseteq e \wedge e'' \sqsubseteq e \wedge \forall e' \sqsubseteq e[\exists t \in s : \text{thought}(t) \wedge \text{HAVE}(e')(t)(x) \wedge \text{CONT}(t) = P]]$

- **Desirable consequence:** with questions, process 'think' will imply that $T_{x,s,\tau}$ for any τ at which a subevent of the thinking event holds would contain only inquisitive thought-sums. This gives us an attitude holder *wondering* P.

Open Questions

Open Questions

Are we really giving up on the alternative semantics for some questions, disjunction?

(51) $\{\lambda w.\text{Ann drank coffee in } w, \lambda w.\text{Ann drank tea in } w\}$

- Currently I don't see a way to keep such sets of propositions and maintain the account.
- If they are allowed, we'll find some inquisitive contents be part of declarative content, e.g.:
- $\{c, t\} \sqsubseteq \{c \cap t\}$

Open Questions

How would this all interact with negation?
Can we predict neg-raising?

- Not without something additional being said.
- With low scope of negation, we get *'generally, x doesn't have a thought P'*:

(52) $$[\![\textsc{gen}\ \ x\ \ \sqrt{think}\ \ P]\!]^s = 1 \text{ iff}$$
$$\textsc{gen}\ s\ \ [x \sqsubseteq s]\ \ \neg\exists t, s' \in s$$
$$[\text{thought}(t) \wedge \textsc{have}(s')(t)(x) \wedge \textsc{Cont}(t) = P]$$

- **Worry:** this looks like it would lose us our account of incompatibility of 'think' with questions.
- So we might want to say that negation can't be low.

Open Questions

- With high scope of negation, we get *'it's not the case that generally, x has a thought P'*:

(53) $$[\![\text{GEN } x \ \sqrt{think} \ P]\!]^s = 1 \text{ iff}$$
$$\neg[\text{GEN } s \ [x \sqsubseteq s] \ \ \exists t, s' \in s$$
$$[\text{thought}(t) \wedge \text{HAVE}(s')(t)(x) \wedge \text{CONT}(t) = P]]$$

- **Worry:** is this meaning too weak?
- Neg-raising does not follow on this account without additional assumptions.

Open Questions

- Could modeling contents as *downward closed sets* of propositions (Ciardelli & Roelofsen 2015, Ciardelli et al. 2018) helps us with some of the issues?
- Is it worth revisiting how subject matters related to this puzzle? Consider about-phrases & aspect in (54):

(54)
a. Mary thought about John. ✗ *State*, ✓ *Process*
b. Mary thought about John that he is the best candidate. ✓ *State*, ✓ *Process*

Thank you!

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