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The Event Structure of Attitudes

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A dissertation presented

by

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DEDICATION

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ACKNOWLEDGMENTS

The story of this manuscript begins in Kristine Yu's office with an accidental discovery that barely made it in, in the end. The road here was long and sinuous, but my committee never lost faith. (They never seemed to, anyway.) Kristine always asked the hard questions, the really foundational ones that made the gears in my brain come to a grinding halt. I know that there was one, during my defense (!), that I couldn't answer. I hope that I did better on all of the other ones. María always saw through the fluff and shone onto me the light of (in)formal pragmatics. I hope that I'll make it there someday. For reasons that escape me, Seth always agreed to be on my committees. During meetings, I would get up, then he would get up, and we'd both start getting excited over something silly at the board—that always made me feel like I must've been doing something right. While others tried to look stern (they did, yikes) and told me to write, Rajesh was able to get me to do it. He said that we would meet every week and write together. We always ended up talking instead, but there's something about the fact that if your advisor's *willing* to take two hours of their time every week to sit there and watch you write, you just have to do it. No two liner can do justice to the fact that Vincent has been there since the very beginning, in Paris, where he taught me all about why snakes had to be near me, and couldn't be near myself. He showed me how to formulate a linguistic hypothesis and how to test it with the elegance of a Frenchman. More importantly, he convinced me that I had something important to say, and gave me the voice to say it.

I am unfortunately not among the linguists who come with the aura of having inhabited South College, but I feel grateful to have visited it before it went to the philosophers. I must be one of the few linguists, though, who have walked through the ILC as it was close to being completed, in a hard hat. The ILC was also a special place to be. Without its regulars and its visitors—my teachers, colleagues and friends—none of this would have been possible. The people in Paris, a person in Vignols and a person in London, the Tu+ community, people at UCLA especially, but also at NYU, MIT, and beyond... have all played their own special part in my becoming the linguist, nay, the human being that I am today. If you doubt it, hit me up, and let's catch up.

♠

I have carried a version of this document with me from Western Massachusetts to Brooklyn and to Paris, to Trondheim and to Ankara. Thank you, for being there.

ABSTRACT

The event structure of attitudes

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This dissertation focuses on what it means to *think that* or to *think whether something is the case*.

First, I show that the type of clause that *think* combines with makes a difference in the kind of attitude a thought report ascribes, and in the kind of eventuality that it describes. With a declarative complement, *think* entails belief and introduces an eventuality description that may (but need not be) stative. With a question complement, *think* introduces an eventuality description that is necessarily dynamic, and often deliberative. In this case, there is no entailment of belief, but one of agnosticism and curiosity about the answer to the embedded question. This, and a second generalization that governs the attitude related and the aspectual properties of *think that* and of *think whether* hold cross-linguistically.

Second, I attempt to square the observation that *think whether* is grammatical and necessarily dynamic with two recent proposals that predict that *think* should be ungrammatical with embedded questions (Mayr, 2019; Theiler et al., 2019). As these go, the excluded middle presupposition, which is associated with *think* to derive neg(ative)-raising with declaratives, gives rise to an anomalous meaning with embedded questions, which is perceived as ungrammaticality. I argue that question embedding and neg-raising do exclude each other, pace White (accepted), but that this is because the former requires *think* to introduce a dynamic description, and the latter requires a stative one (Xiang, 2013; Bervoets, 2014, 2020). I stress that *think whether* is often unacceptable in the sentence frames in which we have been trying to observe it—for example, with the verb in the present simple—but argue that such restrictions are reducible for the most part to interpretive restrictions on dynamic predicates in those frames.

Third, we need to derive the attitude related and the aspectual alternations that *think* gives rise to with declarative and question complements. I propose that *think*'s attitude component encodes the entertain modality from inquisitive semantics (Ciardelli and Roelofsen, 2015, a.o.), which is equivalent to belief in the declarative case and compatible with an inquisitive attitude in the ques-

tion case. Turning to the aspectual alternation, I propose to structure attitude eventualities with embedded clause denotations by relating subeventualities of the former and the alternatives provided by the latter. Declaratives provide a single alternative, which makes it possible to construct a divisive (hence stative) predicate. Questions, on the other hand, provide multiple alternatives, which forces *think whether* to introduce a non-divisive (hence non-stative) predicate.

Finally, I sketch out some ways in which attitude predicates vary in terms of their attitude related and lexical aspectual properties. I ask whether *believe that* and *believe wh-* could be given a treatment similar to *think*. I point out that there are predicates like *know*, *remember* and *agree* that may or must remain stative in question embedding, and speculate whether presupposing truth or belief might be enabling this option. I end with a typology of predicates that should all be possible if the stative/dynamic alternation seen for *think* were free, observe that many are missing and characterize the ones that are.

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Chapter 1

Introduction

1.1 Setting the stage

Attitude predicates lead a dual life. Like many predicates, if not all of them, they describe eventualities. Just like jumping up and down, for example, thinking is something that happens in the world.

(1) When she saw the evidence...

a. Anna thought that Brutus had killed Caesar.

b. Anna jumped up and down.

In addition to describing eventualities, attitude predicates embed clauses and they introduce relations that one bears to the information that clauses introduce, for example, the belief that that information is true.[1]

In this sense, attitude predicates are associated with two sets of properties. Call them event-related and attitude-related properties. The moral of this dissertation is that these two sets of properties are connected. In particular, understanding the former is key in hoping to understand the latter.

To motivate this claim, I focus on the predicate 'think,' the conditions under which it may or may not compose with embedded questions, and the meanings it gives rise to when it does. I show that the attitude-related properties of thought reports are conditioned by some of the event-related

[1] I use the words 'attitude predicate' and 'attitude verb' interchangeably to refer to verbs like 'think,' 'believe,' 'want,' and 'say.' One property of these predicates, of relevance to us, is that they describe (often) mental states or events and take clausal arguments. I remain fuzzy about what defines an attitude verb (although we will be defining some). Thank you to Kristine Yu for asking the challenging questions.

properties of 'think' taken together with its clausal argument. As a result, to understand the former, we need to understand the latter, as well as how these two sets of properties interact.[2]

Consider the partial paradigm and contrasts in (2) (one in acceptability, in (2b), and one in entailments, in (2c)). The pair in (2a) is the baseline. It shows that 'think' is acceptable with declaratives in the present simple and the present progressive. The pair in (2b) suggests that the choice of the present simple vs. the progressive makes a difference in the acceptability of 'think' with an embedded question. And the pair in (2c) suggests that the choice of an atelic vs. a telic frame makes a difference in the meaning of 'think' with an embedded question.

(2) a. (i) Anna thinks that she should invite Brian.
(ii) Anna is thinking that she should invite Brian.

b. (i) #Anna thinks whether she should invite Brian.
(ii) Anna is thinking whether she should invite Brian.

c. (i) Anna spent an hour thinking whether she should invite Brian. [atelic frame]
$\not\rightarrow$ Anna reached a decision.
(ii) It took Anna an hour to think whether she should invite Brian. [telic frame]
$\rightarrow$ Anna reached a decision.

These data show that attitude-related properties of thought reports interact with the aspectual, hence the event-related properties of 'think' with its complement. Indeed, the English[3] present simple typically diagnoses stative eventuality descriptions and the progressive, non-stative ones. This difference seems to condition whether 'think' is able to compose with embedded questions. It is in fact a consequence of the fact that 'think' must be dynamic with embedded questions, but may be stative with declaratives. A similar interaction between attitude and event-related properties arises with telicity, which seems to condition the entailments that 'think' gives rise to with embedded questions. This picture is what we set out to understand.[4]

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[2]Verbs have event-related properties, but larger constituents also do—ones that contain verbs, their arguments and their modifiers. We will ultimately be interested in the event-related properties of attitude verbs taken together with their clausal arguments—that is, of attitude verb phrases. But because coming to this conclusion requires some exposition, I remain less specific at this stage about where the event-related properties under discussion are coming from.

[3]Any discussion of 'English' in this dissertation should be understood here as Mainstream American English. Other varieties of English, especially varieties of African American English, make fine grained tense and aspectual distinctions, which I hope are investigated in future research in relation to attitude reports. See, among others, Green (2002) and DeBose (2015). Many thanks to Tracy Conner and Ayana Whitmal for discussion here.

[4]Under the term 'attitude-related properties,' I lump together the kinds of clauses that attitude predicates may compose with and inferences like belief. Both do pertain to how attitude predicates relate to their clausal arguments, in opposition to the kinds of events that they describe.

Event-related and attitude-related properties of attitude predicates may be studied independently of one another and used to explain the behavior of such properties within these domains. To take a predicate like 'believe,' which a lot of work on attitude reports focuses on, talking about it as a stative description allows us to understand, for example, the tense/aspect combinations that it is (un)acceptable in. Talking about 'believe' as a universal quantifier over possible worlds, on the other hand, allows us to explain why, for instance, someone who believes that not p can also truthfully be asserted to not believe that p. In fact, the latter statement follows from the former. See also (Močnik, 2018) who proposes that there are belief verbs that introduce existential quantification over possible worlds. With Slovenian *dopuščati*, one such verb translated as "allow for the possibility that," *dopuščati not p* and *dopuščati p* are consistent, which is unexpected if *dopuščati not p* entails *not dopuščati p*.

It has also proven fruitful to give eventualities a part in the discussion of attitude predicates' attitude related properties. Contrasts like the following, for example, receive a straightforward explanation if we associate the explanation *event*, in subexample a), with the proposition that Lauren was good at semantics, while associating a fact with that proposition in subexample b). Alternative analyses exist for this pair, of course.

(3) a. Lauren explained that she was good at semantics.
b. Lauren explained the fact that she was good at semantics.

This is an example where positing and manipulating the content of an event argument allows us to capture an attitude-related entailment of 'explain,' namely that Lauren *said* that she was good at semantics in one case, but not necessarily in the other. In doing so, we did not need to talk about what kinds of events explainings are (aside from saying that they are events associated with propositional content) or what kinds of event descriptions 'explain' gives rise to.

And indeed, there seem to be few connections drawn between properties that all event predicates have and attitude related properties of attitude reports. In a sense, talking about the propositional content of an attitude predicate's event argument does not take us too far from the domain of attitude related properties, as only attitude predicates introduce contentful eventualities to begin with. The kinds of connections that I have in mind are generalizations like the following, which relate properties that perhaps only attitude predicates have (e.g., being compatible with quoted complements, or being neg-raising) and more general event-related properties that all predicates have (e.g., being stative or not).

(4) a. All quotatives are non-stative. (Bary and Maier, 2019)

b. All neg-raisers are stative. (Bervoets, 2014, 2020; Xiang, 2013)

In general, the kinds of (proposed) generalizations that do feature in investigations of attitude related properties of attitude predicates do not relate events and attitudes in this way. We mostly find, in the literature, statements of the forms in (5), where the relata are attitude-related properties (although there is a recent push towards the stance I am adopting here, that understanding event and attitude-related properties of attitude reports go hand in hand, e.g., White and Rawlins (2018); White (accepted)).

(5) a. A predicate is responsive iff it is veridical. (Egré, 2008)

b. A predicate is veridical with respect to its declarative complements iff it is veridical with respect to its question complements. (Spector and Egré, 2015)

c. If a predicate is neg-raising, then it is anti-rogative. (Zuber, 1982; Mayr, 2019; Theiler et al., 2019)

1.2 Roadmap

Four chapters follow this introduction and precede a conclusion.

In **chapter 2**, I describe the core aspectual properties of event descriptions formed from combining 'think' with embedded declaratives and questions. The major result of the chapter is that with embedded questions, 'think' necessarily introduces a dynamic description, whereas with declaratives, the description has the option of being stative. This generalization allows us to make sense of the paradigm in (6).

(6) a. (i) Anna thinks that she should invite Brian.

(ii) Anna is thinking that she should invite Brian.

b. (i) #Anna thinks whether she should invite Brian.

(ii) Anna is thinking whether she should invite Brian.

Given that the English present simple most naturally occurs with statives, and the progressive, with non-statives, the acceptability pattern in (6b) is expected: The reason behind the oddness of "Anna thinks whether she should invite Brian" is the same reason as the one behind the oddness of "Anna reads the book." And to the extent that sentences like (6b-i) are acceptable, they describe the same

kinds of situations: A habit, or something that happens soon after utterance time. Compare this with "Anna is thinking whether she should invite Brian" and "Anna is reading the book," which are both acceptable as descriptions of an *ongoing* event.

A second generalization that I describe in this chapter pertains to the meaning contrast in (7).

(7) a. (i) Anna spent an hour thinking whether she should invite Brian.
$\not\rightarrow$ Anna reached a decision.

(ii) It took Anna an hour to think whether she should invite Brian.
$\rightarrow$ Anna reached a decision.

When 'think' and a question is (dynamic and) atelic, the resulting attitude report describes a deliberation and entails that the attitude holder is agnostic and curious about the answer to the question. When it is telic, the attitude report describes a decision and entails that the attitude holder has formed a belief about what the answer is. While I do not elaborate further on the consequences of this generalization at this stage, it might already be interesting to note that agnosticism and curiosity are entailments of predicates like 'wonder' and 'be curious,' while belief is an entailment of predicates like 'know' or 'agree on' (when these predicates compose with embedded questions).

Chapter 3 is a critical review of current proposals that link the unacceptability of sentences like (8), i.e., the anti-rogativity of 'think' and 'believe,' to the fact that these predicates license the neg-raising inference, which goes from (9a) to (9b) (Zuber, 1982; Mayr, 2019; Theiler et al., 2019).

(8) *Anna thinks/believes whether she should invite Brian.

(9) a. Anna doesn't think that she should invite Brian.
b. Anna thinks that she shouldn't invite Brian.

They further explain that neg-raising predicates as a class are unacceptable with embedded questions *because* they are neg-raising. More precisely, the excluded middle presupposition, which derives the neg-raising inference, gives rise to semantic deviance when coupled with a reasonable analysis of embedded questions—a kind of deviance that we perceive as ungrammaticality (Gajewski, 2002).

We will have established by this stage that 'think' is not anti-rogative, or at least not across the board: Composing 'think' with embedded questions is possible, e.g., (6b-ii), and necessarily gives rise to a dynamic description. We will then see that the availability of the neg-raising inference is also in part conditioned by lexical aspect, and specifically that all neg-raising predicates are stative (Bervoets, 2014, 2020; Xiang, 2013). These two observations will entail that, with predicates like

'think,' question embedding and neg-raising exclude each other. However, rather than being directly and causally linked, I will argue that the availability of question embedding and neg-raising are conditioned by an independent common factor, namely lexical aspect. This argument is in part based on the fact that if we attempt to maintain that there is a causal connection between neg-raising and anti-rogativity, we are forced to make additional assumptions that lead to theories of question embedding that are no longer explanatory. This unwelcome result is avoided if we integrate lexical aspect into our analysis.

The discussion leading up to this point will make it clear that there does not seem to be any result in the literature that allows us to make sense of the behavior of 'think' with embedded questions, and its interaction with aspect. **Chapter 4** contains my attempt to do so. I follow recent work in assuming that attitude verbs freely compose with embedded declaratives and questions alike, but argue that there is not anything semantically deviant in composing a predicate like 'think' with the latter (pace Mayr 2019; Theiler et al. 2019).

I propose that 'think' has a meaning component that encodes its attitude related entailments, i.e., the traditional belief with declaratives, but also agnosticism and curiosity with questions, as well as a meaning component that forces the eventuality that 'think' introduces to be structured by the denotation of the clause that the predicate embeds. Concretely, corresponding to the meaning of an untensed (little) verb phrase where 'think' embeds a question, like (10a), we derive a predicate that holds true of eventualities consisting of multiple distinct parts. For the question "who Anna should invite," these parts involve the attitude holder cycling through, so to speak, a list of possible guests and considering the possibility of inviting them, as paraphrased in (10b).

(10) a. [$_{\text{vP}}$ Anna think who she should invite]

b. Anna considers the possibility of inviting Brian, of inviting Carolyn, of inviting Dave, ...

Much like running, and unlike being Dutch or loving Italian food, an eventuality of thinking a question has, as a consequence, subeventualities that are distinct from one another. An activity is thus derived, as opposed to a state—all of whose subparts resemble each other.

Section 5 is dedicated to focused speculation and pointers for further research. In its subsection 5.1, I describe the ameliorating effect that embedded modality, in particular, has on questions embedded under 'think.' This is simply the observation that a sentence like (11b) sounds better than its modal-less counterpart in (11a).

(11) a. *John thought who Bill saw. (Grimshaw, 1979)

b. John thought who Bill could've seen.

I point out the fact that such an effect exists, try to delineate the factors that lead to improvement or degradedness and discuss some analytical options.

Next, in subsection 5.2, I turn to what 'think' teaches about some other attitude predicates including 'wonder,' 'believe,' and factives like 'know' and 'remember.' Like 'think,' 'believe' too is only able to embed questions in certain sentence frames and not in others, but the terms of the alternations that the two predicates undergo are different. Observe in (12) that questions are out with both predicates in the present simple, that various frames improve question embedding for both predicates, and that the behavior of the two predicates come apart in other frames, e.g., under the progressive.

(12) a. (i) *Anna believes who she should invite.

(ii) *Anna thinks who she should invite.

b. (i) Anna couldn't believe who she should invite.

(ii) Anna couldn't think who she should invite.

c. (i) It took Anna an hour to believe who she should invite.

(ii) It took Anna an hour to think who she should invite.

d. (i) *Anna is believing who she should invite.

(ii) Anna is thinking who she should invite.

We will ask whether the event-related properties of 'believe' may also help explain the alternations it exhibits in its compatibility with embedded questions.

Turning to 'know' and 'remember,' coming from our account of 'think' composed with embedded questions, we might expect embedded questions to force attitude eventualities to be dynamic across the board. The class of cognitive factives, in particular, are interesting in that they are perfectly acceptable with embedded questions while remaining stative. This is illustrated in (13), where the present simple is our test for stativity.

(13) a. Anna knows who she should invite.

b. Anna remembers who she should invite.

Among these predicates, ones like 'remember' are particularly interesting as they are able to alternate

between being stative and dynamic apparently freely. Indeed, alongside (13b), examples like (14) are also possible. They describe a change in the list of names that the attitude holder is considering, suggesting that we are dealing here with a dynamic eventuality description.

(14) Anna is remembering who she should invite.

We will ask what allows a predicate to remain stative with embedded questions, and we will speculate as to whether presupposition might have anything to do with this.

Finally, we will have seen at this point many properties that 'think' has and some properties that other attitude predicates have. In section 5.3, we will focus on the observation that a predicate with the interpretive properties that 'think' has with declaratives and questions is not expected to exist given available generalizations on the meaning of attitude verbs—specifically ones that are due to Spector and Egré (2015) and Roelofsen and Uegaki (2020). Following up on this observation, we will speculate as to what kinds of predicates are expected to be possible and what kinds, impossible, if we take their lexical aspectual properties into consideration.

Once we have accepted the possibility of shaping eventualities corresponding to attitudes with embedded clause denotations, it will appear that we have much more work to do. By the end of this dissertation, I am hopeful that we will know where to begin.

1.3 General background on lexical aspect

1.3.1 Categories and diagnostics

Sentences describe events. If I say (15), I am describing something that happened—an event. I am saying that that event is a run, that its agent is Anna, that it exists, and that it exists in the past.

(15) Anna ran.

That the event is a run is a privileged piece of information. We will say that 'run' is an event description. Its meaning is the set consisting of all and only events of running. This set will contain events of various shapes and sizes: Ones that were fast or slow, ones that ended at UMass or happened in the snow, ones that involved Anna running or her cat running, etc. We can also talk about the set consisting of all and only events of Anna running. This is also a kind of event description that we will be interested in, which corresponds to the meaning of 'Anna run,' a verb and one of its arguments.

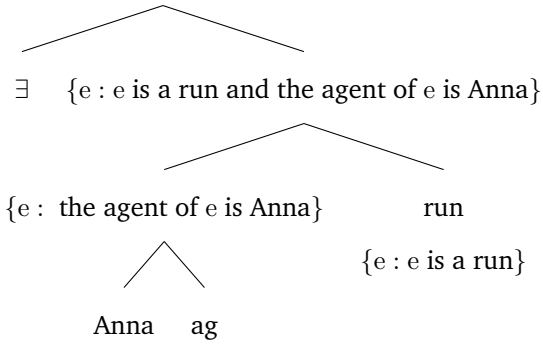
(To talk about event descriptions, I will also use the terms 'event predicate.' An event predicate is simply a set of events, e.g., one consisting all and only of events of running, or of events of Anna running, and so on. Unlike with 'attitude verb' and 'attitude predicate,' the distinction between the 'verb' and 'predicate' does matter here—verbs describe events, but so do larger pieces of structure consisting of verbs, their arguments and modifiers. The former are also event predicates, but they are not what we would call a verb.)

There are many interesting event descriptions that we can build up: Ones that describe events whose agent is Anna, ones that happened in the past, ones that can only happen after the pandemic is over, and so on. These are not directly relevant for the present study. We will focus on event descriptions contributed by verbs ('run') or by verbs composed with some of their arguments ('Anna run'), and more specifically on event descriptions introduced by verbs that compose with clauses.

***

It is worth getting our hands slightly dirty and looking at one way of computing the truth conditions of a sentence like 'Anna ran.' In the tree below, we have three event descriptions. The verb 'run' denotes the set of events of running. The constituent 'Anna ag' denotes the set of events whose agent is Anna. (The (silent) functional morpheme 'ag' composes with an individual argument and returns the set of events whose agent is that individual.) And the constituent 'Anna ag run' denotes the set of events that are runs whose agent is Anna. The lower two event descriptions compose through set intersection.

(16) $\exists e' : e' \in \{e : e \text{ is a run and the agent of } e \text{ is Anna}\}$



Once we have formed the set of runs by Anna, existentially quantifying over that set will yield a true statement if there is anything in the set of runs by Anna, a false one otherwise.

Various other things may (and have to, in a more accurate model) happen to event descriptions aside from or in addition to saying that such events exist. Of importance for us, events will have to

be located in time. The sentence 'Anna ran,' for example, describes an event that happened in the past, whereas 'Anna is running' describes an event that is happening now. I do not show a way of doing so until section 4.4.2.

***

There are many different kinds of events, some of which are described by the sentences in (17).

(17) a. Anna bottled booch.
b. Anna bottled the booch.
c. Anna noticed the scoby.

Less obvious is that we can organize these events or their descriptions into a manageable number of categories. We do so based on our intuitions about the structural properties of the events themselves and on the linguistic behavior of the expressions that we use to describe them. We have the intuition, for example, that bottling booch takes time, but that noticing the scoby happens instantaneously. Corresponding to this intuition that there is something different about the events involved, there are differences in the linguistic behavior of their descriptions.

Like many others, I will refer to these properties as event descriptions' lexical aspect. 'Aspect' is for how we quite literally *see* these events. 'Lexical' is a misnomer: Many of these properties are derived in the composition and only in part determined by lexical meaning.

***

Two main distinctions among event descriptions are relevant for the upcoming discussion. The first one distinguishes between events and states. Different kinds of events were illustrated in (17). They contrast with states, illustrated in (18).

(18) Anna knew Italian.

The intuitive difference in the situations involved is that, usually, events involve some kind of change, whereas states do not. There is change in coming into or out of a state—like learning Italian or forgetting it, as far as knowing Italian is concerned—but this change is neither internal to or characteristic of the state.

Statives, in English, have the characteristic property of being acceptable in the present simple and this, with the meaning that the state described holds at utterance time. Eventives in the present

simple cannot describe an ongoing event. That is, example (19b) cannot be used to say that Anna is bottling booch now (this is what the '#' indicates). A prominent reading that eventives do give rise to out of the blue in the present simple is habitual. Example (19b) can be understood to mean that "Anna habitually bottles booch," but this understanding is not what we are after here.

(19) a. Anna knows Italian.
b. #Anna bottles booch.

This pattern flips in the progressive. Statives are usually unacceptable in the progressive. While there are ways of getting them to be acceptable in the progressive, this is costly and gives rise to layers of meaning absent from their simple tense counterparts. In contrast, the eventives that we will be interested in are acceptable in the (present) progressive where they are able to describe ongoing events.

(20) a. #Anna is knowing Italian.
b. Anna is bottling booch.

A terminological note is in order here. The term 'state' and its derivatives are unambiguous—although there are different kinds of states. The term 'event' is used in different ways. I will sometimes use it to mean 'non-state' and sometimes as a cover term for anything that is either a state or a non-state. 'Eventuality' is also a cover term for states and non-states. Talking about event descriptions, the term 'stative' is transparent. In opposition to 'stative,' I interchangeably say 'dynamic' or 'eventive.'

The second distinction of interest to us is the one between telic and atelic eventuality descriptions. The intuitive difference between the two is that the former describe eventualities that have a natural endpoint, while the latter describe ones that do not. For example, 'bottle the booch' talks about events with the natural endpoint that when all of the booch has been bottled, those events end. In contrast, 'bottle booch' describes activities that have no 'natural' endpoint and that, in principle, may go on indefinitely.

The core linguistic diagnostic for telic vs. atelic eventuality descriptions is that telic descriptions may be modified by 'in n time' but not by 'for n time,' and for atelic descriptions, the pattern is flipped. This is illustrated in (21).

(21) a. Anna bottled the booch #for/in an hour.

b. Anna bottled booch for/#in an hour.

We will encounter cases where modification by 'in' adverbials is independently restricted. For these cases, I will use the 'take n time' diagnostic, which patterns similarly in only being acceptable with telic eventuality descriptions.

(22) a. It took Anna an hour to bottle the booch.
b. #It took Anna an hour to bottle booch.

To keep the present discussion short, I discuss additional diagnostics as they become relevant. The lesson here is that stative descriptions pattern differently from dynamic ones, and that telic descriptions pattern differently from atelic ones. The category of events proper contains activities, accomplishments and achievements. Activities are atelic (so are states). Accomplishments and achievements are telic. (Achievements will not play a central role here.) This classification, usually attributed to Aristotle, Dowty (1979), and Vendler (1967), is summarized in (23).

(23) lexical aspectual categories:

a. (i)	Anna bottled the booch.	[accomplishment, telic]
(ii)	Anna bottled booch.	[activity, atelic]
(iii)	Anna noticed the scoby.	[achievement, telic]
b.	Anna knew Italian.	[state, atelic]

***

It is not always easy to determine whether we are talking about properties of events or properties of their descriptions. Nor is it easy to determine whether we are talking about properties of event descriptions, or of the sentences containing them.

The one and the same event of Anna bottling a specified quantity of booch can alternatively be described as 'bottling booch' or 'bottling the booch,' a point made by Krifka (1998) at least. This suggests that telicity is a property of event descriptions even though we talk about events having endpoints or not. Turning to the second point, what are otherwise stative descriptions sometimes pattern as if they were eventive and eventive predicates sometimes pattern as if they were stative. For example, a sentence like (24) describes change, even though it is built up from a stative eventuality description.

(24) Anna suddenly knew Italian.

On the other hand, the second sentence in the narrative sequences in (25a) pattern similarly in that they provide background information and do not advance narrative time. This is typically taken to be a property of statives, and we see that the progressive of an activity predicate patterns like a stative in this respect. However, the behavior of predicates that are lexically stative, in (25a-ii), and ones that are lexically dynamic, in (25b), come apart in the simple past: The latter is most naturally interpreted as moving narrative time forward.

(25) a. (i) I entered the restaurant. Anna was bottling booch. She helped me with my order.
(ii) I entered the restaurant. Anna knew Italian. She helped me with my order.
b. I entered the restaurant. Anna bottled booch. She helped me with my order.

We will particularly be interested in the distinction between states and activities, which are both atelic predicates. The distinction between the two is not always thought to be clear cut (Arche, 2006), even though we do have the intuition that activities 'happen' while states do not (compare, for example, (25a-i) and (25a-ii)). A not-so-naïve intuitive difference between states and activities goes as follows. If 'knowing Italian' is true of a state s, then the same description is true of every subpart of s. On the other hand, if 'bottling booch' is true of an event e, then while we will find subparts of e that count as events of bottling booch, not all subparts of e will satisfy this event description. Tipping the booch jar constitutes part of a booch bottling, but it does not itself count as a booch bottling.

Some other differences are that activities can happen or be performed by agents, whereas states cannot, as suggested by (26):

(26) a. What happened was that Anna ran/#knew Italian.
b. What Anna did was that she ran/#knew Italian.

Relatedly, activities can be performed 'carefully,' 'deliberately' or 'intentionally,' but not states. (Not all activities are agentive, so some do not pass this test.)

(27) a. Anna ran carefully/deliberately/intentionally.
b. #Anna knew Italian carefully/deliberately/intentionally.

Another difference, which, to my knowledge, is a novel observation, is that activities but not states

can be modified by modifiers like 'one by one.'

(28) a. The students ran one by one.
b. #The students knew Italian one by one.

Two final diagnostics are the possibility of forming the imperative of an activity description with a command interpretation, and the possibility of embedding the former under 'force' or 'persuade.'[5]

(29) a. Run!
b. #Know Italian!

(30) a. Alice forced/persuaded Bob to run.
b. #Alice forced/persuaded Bob to know Italian.

In sum, while the differences between activities and states might, on some levels, be tenuous, it seems like they do pattern differently in several linguistic contexts. I will thus adhere to the position that there is a meaningful difference between the two.

1.3.2 Alternations

Some event descriptions seem to belong to more than one lexical aspectual category or to change categories depending on other expressions in a sentence.

Regarding telicity, Kratzer (2004) observes that some verbs "show [both] telic and atelic behavior according to the standard tests." Some of Kratzer's examples are given in (31). This is a case where a given event description, e.g., "examine the patient" seems to belong to two lexical aspectual categories, namely to activities and to accomplishments.

(31) a. (i) The doctor examined the patient for/in an hour.
(ii) We cooked the egg in/for five minutes.
(iii) We milked the cow in/for ten minutes.
(iv) She cleaned the house in/for two hours.

On the other hand, in examples like (32), we see that whether a verb introduces a telic or an atelic description seems to depend on whether its arguments or modifiers introduce bounded quantities

[5]One justly wonders about injunctions like 'γνῶθι σεαυτόν.' This feels like a more acceptable command than '#Know Italian!' but similar imperatives typically do not occur as 'go' imperatives: 'Go run!' vs. '#Go know yourself!' (Lakoff, 1966).

or not (Krifka, 1989, 1998, a.o.).[6]

(32) a. (i) Anna drank this glass of booch #for/in 5 minutes.
(ii) Anna drank booch for/#in 5 minutes.
b. (i) Anna ran a mile #for/in 5 minutes.
(ii) Anna ran around for/#in 5 minutes.

Some of these changes in category feel natural, some, less so. Consider, for example, the contrast between a. and b. in (33), which illustrates a shift between the description of a state and that of an activity, both built up from the same stative description 'be available.' We get the sense that sentence b. is less acceptable out of the blue and that it has layers of meaning absent from sentence a. In particular, the sentence receives the paraphrase that Tom is acting available.

(33) a. Tom is available.
b. ?Tom is being available.

Similar shifts in lexical aspect are referred to as coercion—here, a stative description may be thought to be coerced into describing an activity.

I will refer to cases where event descriptions seem to change aspectual categories as aspectual alternations. There might be a narrow sense of this word, which refers to cases where the change is conditioned by factors external to the description and where it feels natural, as in (32). In contrast, examples like (31) are perhaps cases of ambiguity or underspecification, while examples like (33) are, as we have said, cases of coercion. My use of the term 'alternation' will be loose, covering all cases where we see the same linguistic expression introducing event descriptions that belong to different lexical aspectual categories.

***

One kind of alternation that we will focus on is illustrated in (34), where 'think' is able to introduce a stative description, in (34a), and an activity description, in (34b).

(34) a. Anna thinks that she should invite Brian.
b. Anna is thinking whether she should invite Brian.

This alternation is in part conditioned by the choice of a declarative or an interrogative as *think*'s

[6]Achievement predicates undergo a similar alternation: *Carol shot a rabbit* (achievement), *Carol shot rabbits* (activity). Thanks to Seth Cable for bringing this to my attention.

clausal argument. In this sense, it has the profile of the telicity alternations illustrated in (32) where a verb's arguments or modifiers affect affect the resulting event predicate's lexical aspectual properties. While these are relatively well understood, the effect of clausal arguments on lexical aspect are, to my knolwedge, largely unexplored.

Coming close to the one in (34), an alternation that affects some statives is that when they are used to describe an inherent property of their subject, they are natural in the present simple but not in the progressive, and when this property is subject to change, the pattern is flipped.[7]

(35) a. My socks are lying/*lie on the bed.

b. New Orleans *is lying/lies at the mouth of the Mississippi. (Dowty, 1979)

This kind of difference will be relevant to us in describing the behavior of sentences like (36), where declarative embedding 'think' occurs in the progressive.

(36) Anna is thinking that she should invite Brian.

However, the alternation in (35) is distinct from the one in (34). Indeed, example (35a) involves a stative in the progressive which is understood as describing an ongoing state. In contrast, as I argue in detail in chapter 2, example (34b) is describing an ongoing activity.

In the realm of attitude verbs and sentence embedding, alternations between stative and non-stative uses of predicates are known to exist. Example (37a) is taken from Anand et al. (2019) and involves a stative use of the predicate 'demonstrate.' This stative use alternates with a dynamic use illustrated by (37b). Here, the conditioning factor seems to be the choice of an animate vs. an inanimate subject.

(37) a. The time of death demonstrates that the butler is the murderer. (Anand et al., 2019)

b. (i) #Holmes demonstrates that the butler is the murderer.

(ii) Holmes is demonstrating that the butler is the murderer.

It is also known that some attitude verbs alternate between describing states or non-states when they are used with non-clausal arguments. For example, 'understand,' 'believe' and 'know' are usually unacceptable in the progressive, but sometimes possible—as suggested by (38). (The sources given

[7] See Husband (2010) for a similar alternation between stage-level and individual-level stativity: *Monkeys live in trees* vs. *Monkeys live in this tree*. The former describes a property of monkeys as a kind, the latter may be an existantial statement along the lines of 'there are monkeys living in this tree' (consistent with a state of affairs where monkeys in general do not live in trees).

for these sentences are cited from Filip (2012).)

(38) a. I'm understanding you but I'm not believing you. (Bach 1981)

b. I am understanding more about quantum mechanics as each day goes by. (Comrie 1976)

c. John is knowing all the answers to test questions more and more often. (Binnick 1991)

The study of attitudes and the study of events both have a venerable history in formal semantics, neither of which do justice to this seemingly untamed list of aspectual alternations. In the rest of this dissertation, we will focus our attention to lexical aspectual alternations undergone by 'think' and a handful of other attitude predicates, with the hope of better understanding attitudes and events through the intricate ways in which they interact.

Chapter 2

The aspectual profile of question embedding 'think'

2.1 Categorizing 'think': Conflicts and alternations

Work on 'think' contains implicit and explicit commitments about its descriptive properties that, when taken together, are puzzling. The complexity of the predicate's lexical aspectual properties is not often discussed. Alongside the familiar stative thought reports, we find that 'think' gives rise to dynamic descriptions with quotes or with 'about' PPs (Rawlins, 2013). When the existence of both stative and dynamic descriptions with 'think' is acknowledged, the latter might be set aside to focus on the former (Katz, 2008). Anecdotal but revealing is that, in an otherwise comprehensive discussion of English verb classes, Levin (1993: p. 202) leaves verbs that take sentential complements for further research. This suggests that the gap concerning 'think' corresponds to one that is more general.

Turning to its attitude related properties, the predicate is listed among canonical neg-raising predicates, where we also find the acknowledgment that these predicates are not always neg-raising (Bartsch, 1973; Gajewski, 2005; Xiang, 2013; Bervoets, 2014, 2020, a.o.). It is listed among canonical anti-rogative predicates, but we know here too that whether a given predicate is able to compose with questions sometimes depends on factors other than the lexical properties of the predicate itself (Paillé and Schwarz, 2018; Mayr, 2019; Roberts, 2019; White, accepted, a.o.).

In this section, I present these statements and some of the data that is used to back them up. I then turn to showing that 'think' genuinely alternates between stative and not, neg-raising and

not, and anti-rogative and not. Moreover, I show that these alternations are governed by rule: The first one correlates with the other two. Specifically, when 'think' is stative, it is compatible with neg-raising and incompatible with question embedding. When it is non-stative, it is compatible with question embedding, but incompatible with neg-raising. That these patterns hold across languages brings further support to their regularity.

2.1.1 Are VPs headed by 'think' stative or non-stative?

In discussions of its attitude related properties, 'think' is found in frames like (1), in the present simple and with a 'that' clause, where it occurs as a stative predicate. (I will sometimes talk as if the predicate itself was stative, dynamic, etc. These properties more accurately apply to VPs headed by 'think,' or in more neutral terms, to objects formed by composing 'think' and its arguments.)

(1) John thinks that the sky is blue.

In the general case, however, 'think' sometimes describes states, and sometimes, non-states (both telic and atelic ones, as we will see). I quote Katz (2008) here, who writes:

> [A number of verbs listed as state verbs] have eventive uses as well as stative uses. This can be illustrated with the verb 'think': when used in the progressive (as in [his] 11b) or as part of a wh-cleft (as in 11c) it has an eventive reading, while when used in the simple present tense (as in 11a) it has a stative reading.

(11) a. John thinks that the sky is blue. (stative)
b. John is thinking about Mary. (eventive)
c. What John did was think about Mary. (eventive)

As expected, on the eventive readings 'think' is compatible with manner adverbial modification while on the stative readings it is not[1]:

(12) a. ??John thinks worriedly that the sky is blue.
b. John was thinking worriedly about Mary.
c. What John did was think worriedly about Mary.

[1]The earliest mention of this test that I know of is in Lakoff (1966), who characterizes the relevant class of manner adverbs as ones that are "subcategorized with respect to sentence subjects."

We will uniformly set aside the non-stative reading of such verbs. (Katz, 2008)

While aspectual alternations with other predicates do receive some attention in the literature (Krifka, 1989; Kratzer, 2004; Rothstein, 2004, a.o.), attitude reports are understudied in this respect. Katz's examples show that 'think about X' may be eventive. In fact, it must be. Examples like (2) lack an ongoing state understanding, which would be available if 'think about X' could be stative. (As also seen in section 1.3, eventives in the present simple are compatible with a habitual understanding, which (2) has.)

(2) #John thinks about Mary

For 'think that,' Katz seems to be drawing the conclusion that the construction is obligatorily stative, citing the unacceptability of his (12a). There is more to be said here. It is true that 'worriedly' does not naturally modify statives. But his (12a) does not give 'think that' a chance to show its non-stative behavior if it has one, as the example is in the present simple. In (3), we see that 'think that' readily occurs in the progressive, which suggests that the conclusion that it must be stative does not come straightforwardly. We also find that 'worriedly' is acceptable here, although there are some pragmatic effects associated with such sentences.[2]

(3) a. (i) John is thinking that the sky is blue.
(ii) John is worriedly thinking that the sky is blue.
b. John is worriedly thinking that Tom Cotton is the ideal presidential candidate for 2024.
c. John is worriedly thinking that the sky is yellow. I hope it's not his new meds.

It is revealing that Katz uses different complements to illustrate stative vs. non-stative uses of 'think.' As we will see throughout this dissertation, the aspectual classes that 'think' falls into depend in part on the choice of its complement.

2.1.2 Does 'think' embed questions or not?

Much work on clause embedding assumes that 'think' embeds declaratives but not questions. Theiler et al. (2019) write, and I quote:

> It is a long-standing puzzle why verbs like 'believe' and 'think' take declarative but not interrogative complements (e.g., *Bill believes whether Mary left), while closely related

[2]Thanks to Travis Major for judgments and discussion.

verbs like 'know' and 'be certain' take both kinds of complements. (Theiler et al., 2019)

Examples like (4) are often found suggesting that 'think' might indeed be incompatible with questions:

(4) a. (i) John thought that Mary left.
(ii) *John thought why Mary left. (Rawlins, 2013)

b. (i) *John thinks whether Mary drinks.
(ii) *John doesn't think whether Mary drinks. (Mayr, 2019)

c. (i) *I thought whether to invite Bill to the party.
(ii) *I thought who will be invited to the party. (Dayal, 2016)

d. (i) John thought that Bill saw someone.
(ii) *John thought who Bill saw. (Grimshaw, 1979)

But in addition to examples like (4) there are also ones like (5), which suggest the opposite conclusion.

(5) a. (i) I'm thinking whether to invite Bill to the party.
(ii) I'm thinking who to invite to the party. (Dayal, 2016)

b. (i) And it does cause you to think whether or not it makes sense for us to be here.
(ii) I'm trying to think whether I'd have been a star today or not. (White, accepted)

Such examples can be elicited, occur naturally in conversation, and are attested online.[3]

(6) a. Think what your father would say.

b. I can't think why you left early, Ruth.

c. Now can you think what the mirror of Erised shows us all?

d. When Donald Trump says something, he isn't thinking whether it is true or not.

e. 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."

f. 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.

[3]Example (6a) was volunteered by Seth Cable. Example (6b) comes from a *Columbo* episode and was brought to my attention by Vincent Homer. Example (6c) comes from J. K. Rowling's *Harry Potter and the Sorcerer's Stone*. Examples (6d) and (6e) were recovered from a Google search. Finally, example (6f) reports the words Attorney Ben Crump from the 'NPR news now' podcast, 08/26/2020 4AM ET.

Notice also that 'think' is acceptable with questions in a broad range of grammatical environments: Under some modals, in the progressive, the infinitive, the imperative, when negated/unnegated, etc.

One of the central descriptive claims of this dissertation is that when 'think' embeds questions, the resulting event description must be non-stative. It is then perhaps unsurprising that some of the examples in (4) should be unacceptable: They involve 'think' with a question in the present simple, which is most natural with stative predicates (a simplification, for now). In contrast, the range of environments involved in the acceptable examples in (5) and (6) are either ones that are compatible with non-stative predicates or ones that force a predicate to be non-stative—like the progressive or the imperative. It is then relatively unsurprising to find that 'think' with a question, a dynamic predicate, is acceptable with questions there. This central descriptive claim does not suffice to account for all of the ungrammatical examples in (4): The simple past is compatible with statives and non-statives alike, so the simple past examples in (4) are expected to be acceptable. Let us hold on to this thought for now.

2.1.3 Is 'think' neg-raising or not?

The (assumed) unacceptability of 'think' with embedded questions is sometimes made to follow from the fact that the predicate is neg(ative)-raising (Zuber, 1982; Mayr, 2019; Theiler et al., 2019, a.o.). This is a phenomenon whereby certain attitude reports of the form in (7a), where negation is pronounced on the matrix verb, are understood as in (7b), where negation is in the embedded clause.

(7) a. Anna doesn't think that Brutus killed Caesar (until March 15th).
b. Anna thinks that Brutus didn't kill Caesar (until March 15th).

The acceptability of a strict NPI like punctual 'until' in the embedded clause in (7a) ensures that we are indeed dealing with neg-raising (Gajewski, 2005, section 2.1). (Two other strict NPIs are 'in years' and 'either.') We will use this test or see it used over and over again, so it is worth mentioning that predicates that do not license the neg-raising inference do not allow for strict NPIs in their complement when they are negated, like 'claim,' in (8).[4]

(8) Anna didn't claim that Brutus killed Caesar (*until March 15th).

[4]Why not just rely on the intuition that 'not think' implies 'think not' and that 'not claim' does not imply 'claim not'? I see at least two reasons: One is that the strict NPI test turns the task of detecting an inference into a perhaps more reliable judgment of acceptability. Another is that there might be inferences that look like, but are not, the neg-raising inference. Tests like strict NPI licensing should pick up on the difference.

Weak NPIs like 'anyone,' on the other hand, may occur in the complements of (negated) neg-raising and non-neg-raising predicates alike:

(9) a. Anna doesn't think that Brutus killed anyone.
b. Anna didn't claim that Brutus killed anyone.

It is often noted that the neg-raising inference can be suspended given the right context (Bartsch, 1973; Gajewski, 2005, a.o.). For example, if we make it explicit that the attitude holder is agnostic with respect to whether the embedded proposition is true or not, the inference from 'not think' to 'think not' does not arise.

(10) a. **Context**: Anna has no knowledge of Roman history so...
b. She doesn't think that Brutus killed Caesar.
(This sentence does not imply that Anna thinks that Brutus didn't kill Caesar.)

In addition to ways of suspending the neg-raising inference via the pragmatic context, Xiang (2013) and Bervoets (2014, 2020) point out that eventive predicates are not neg-raising. In particular, when 'think' is made to be eventive, the neg-raising inference is not drawn. This is illustrated in (11) with examples from Bervoets (2014, 2020).[5]

(11) a. *The farmer wasn't thinking the tree fell until late last night when the barking dog startled him out of his reverie this morning. Bervoets 2014: ex. (186a), p. 112
b. As they turned the corner, the farmer wasn't thinking rain would help the situation.
Cannot be interpreted as: "As they turned the corner, the farmer was thinking that rain wouldn't help the situation."
Bervoets 2014: ex. (186b), p. 112; Bervoets 2020: ex. (369), p. 124

White (accepted), on the other hand, provides the following example, which suggests that 'think' may be neg-raising in the progressive. The descriptive claim is that (12) does have a neg-raising understanding, and this conflicts with the claim that that understanding is unavailable in examples

[5]Xiang attributes to a personal communication by Jim Huang the observation that aspect and the availability of neg-raising correlate across languages. I am unsure, and Bervoets does not say, what exactly makes the sentences in (11) eventive. One is tempted to say that it is the use of the progressive, but progressives of statives are possible. In particular, we will see in section 2.2.4 that the progressive is possible in stative thought reports. One might also think that it is the temporal modifiers '*when...*' and '*as...*,' but at least some statives are compatible with some kinds of temporal modification: *Die 3 war gestern/seit diesem Tag/zweimal/jahrelang Pauls Glückszahl* "3 was Paul's lucky number yesterday/since this day/twice/for years" (Maienborn, 2005). I return to the stativity/dynamicity of 'think' with declaratives in section 2.2.4.

like (11), which also involve progressive 'think.'[6]

(12) I wasn't thinking there was a way to help more than one person (at a time) until Jo got back from lunch. White accepted: ex. (18), p. 13
Paraphrase (mine): The speaker's belief was that there was no way of helping more than one person at a time until Jo got back.

In section 3.3.1, I will argue that progressive 'think' can be understood as a stative or as a non-stative description, and that under its stative guise, the neg-raising inference is available, as in (12), but that under its non-stative guise, the inference is unavailable, as in (11). (This will of course entail full commitment to the—known but ill-understood—fact that the English progressive is compatible with stative eventualities.[7]) While I will have to leave for further research an account of why neg-raising might be sensitive to stativity, I will use this descriptive pattern to evaluate proposals that explain *think*'s (assumed) incompatibility with embedded questions in terms of the neg-raising inference.

We have seen that the behavior of 'think' is not uniform with respect to some of its event-related properties and to some of its attitude-related properties, and that alternations in the former correlate with alternations in the latter.

2.1.4 About 'about'

Before moving on to a more precise description of these alternations and ultimately to an explanation, I would like to dispel a worry that might arise concerning 'think' with questions. Examples like (13) show that 'think' may compose with questions if these are introduced with the preposition 'about.'

(13) Anna is thinking about whether she should invite Brian.

The worry is that examples like (14a), where there is no preposition in the string, do in fact contain one, but one that happens to be unpronounced.[8]

(14) a. Anna is thinking whether she should invite Brian.

[6] White (accepted: fn. 7, p. 12) provides the following context: "For those having difficulty obtaining the low attachment reading, consider an context wherein the speaker's manager is questioning why they, as team leader at a help desk, were serving only one customer at a time, when the help desk was staffed with three people."

[7] Kenny (1963) is the first, to my knowledge, to point out that attitude statives like 'hope' and 'intend' can be used in the progressive, while retaining a stative meaning. He writes, p. 123 of the 2003 edition of his book: *Many verbs for states have an idiomatic continuous present ("I am hoping," "I am intending"). These are not genuine continuous presents: for them, but not for true continuous presents, the rule holds "A is ϕing if and only if A ϕs".*

[8] This is reminiscent of 'that' omission.

b. Anna is thinking ~~about~~ whether she should invite Brian.

There are several arguments against the hypothesis that examples like (14a) contain a silent preposition.

First, with 'think,' the preposition 'about' introduces DPs and gerunds in addition to questions. However, with DPs and gerunds, the preposition cannot be left out.

(15) a. (i) Anna is thinking about Brian.
(ii) *Anna is thinking Brian.
b. (i) Anna is thinking about inviting Brian.
(ii) *Anna is thinking inviting Brian.

Second, even when the preposition introduces questions, it cannot always be left out. Contrast the a. sentences with the b. sentences in (16).

(16) a. (i) John is thinking about why Mary left.
(ii) John is thinking about why Mary could've left.
b. (i) *John is thinking why Mary left.
(ii) John is thinking why Mary could've left.

When 'think' is in the progressive, the preposition is obligatory with an embedded question of the form "why Mary left," but optional with "why Mary could've left," when a modal is introduced. (I will leave this contrast as a puzzle for now. Looking back at (6), however, observe that not all examples of 'think + Q' require a modal in the embedded question to be acceptable.[9])

The two sets of examples in (16) and (15) are unexpected under the hypothesis that there is a silent preposition in sentences where 'think' appears to compose with questions directly. If leaving the preposition out is an option, we should also be able to leave it out with DPs, gerunds, and non-modalized embedded questions—contrary to observation.

The third piece of evidence comes from Turkish (likely an example of a broader cross-linguistic pattern). In Turkish a predicate *düşün-*, 'think,' may compose with embedded questions whether a postposition is expressed or not. The presence or absence of the postposition correlates with an overt

[9]This modal requirement might, in addition to the focus on present simple examples, have contributed to the impression that 'think' does not embed questions. Barbara Partee (p.c.) reports that she does not fully reject examples like "Anna's thinking who had written about that before," where there is no modal in the embedded clause. But she mentions the possibility that this embedded question might be construed as being related to "who should I cite?" which does contain a modal.

difference in case on the embedded clause, which would be puzzling if adpositions were simply not pronounced when absent. In (17), a bare clausal complement of *düşün-* is in the accusative, while there is no overt realization of the accusative with the postposition *hakkında*, 'about.'

(17) a. Anna [kimi davet etmesi gerektiğin-i] düşünüyor.
Anna who.ACC invitation do.INF.3S MOD.NMZ-ACC think.IPFV
Anna is thinking who she should invite.

b. Anna [kimi davet etmesi gerektiği hakkında] düşünüyor.
Anna who.ACC invitation do.INF.3S MOD.NMZ.NOM about think.IPFV
Anna is thinking about who she should invite.

Finally, the presence or absence of 'about,' in English, makes an interpretive difference. Example (18a), without 'about,' has a prominent understanding where at the end of the hour, Anna has reached a conclusion as to who she should invite. This inference is absent in the sentence (18b), with the preposition. (We will return to the description of these facts in section 2.3.1 and 2.3.2.)

(18) a. It took Anna an hour to think who she should invite.

b. It took Anna an hour to think about who she should invite.

Interestingly, this interpretive contrast replicates in Turkish as well, which suggests that there is no accident here.

(19) a. [Anna'nın [kimi davet etmesi gerektiğini] düşünmesi] bir saat aldı.
Anna.GEN who.ACC invitation do.INF MOD.NMZ think.INF one hour took
It took Anna an hour to think who she should invite.

b. [Anna'nın [kimi davet etmesi gerektiği hakkında] düşünmesi] bir saat aldı.
Anna.GEN who.ACC invitation do.INF MOD.NMZ about think.INF one hour took
It took Anna an hour to think about who she should invite.

Because of the syntactic and semantic differences sketched out above, I will be assuming that when 'think' combines with an embedded question and we do not see a preposition 'about' in the string, there is no preposition in the structure either.

2.2 Generalization one: 'Think + Q' must be dynamic

In this and the next section, I present two novel generalizations that describe the behavior of 'think' when the predicate composes with embedded questions.

The first generalization states that thought reports with embedded questions cannot be stative, or, equivalently, that these must by dynamic. This is effectively a condition on the environments in which we expect to observe 'think' with embedded questions. If that environment only hosts stative predicates, this will not be possible. But if the environment is compatible with dynamic predicates, it will be. This makes the pattern that this generalization captures, illustrated by the pair in (20), look like it involves selection. But the claim is in fact about the meaning that 'think' gives rise to with embedded questions.

(20) a. #Anna thinks who she should invite.
b. Anna is thinking who she should invite.

The upcoming discussion will make use of traditional diagnostics that disambiguate in favor of different lexical aspectual categories. These diagnostics are introduced in many places, while the present discussion draws primarily on Lakoff (1966), Dowty (1979), Rothstein (2004) and Levin (2009).

2.2.1 'Think + Q' can be a dynamic eventuality description

Thought reports with embedded questions pass all of the tests that diagnose dynamic predicates. This suggests that they can be dynamic.

The starting point is the intuition that sentences like (21) involve the attitude holder *doing* something.[10]

(21) a. Anna's thinking who she should invite to the party.
b. Anna thought who she should invite to the party.

This intuition is further corroborated by the acceptability of the examples with pseudo-clefts in (22), which make explicit the fact that the thinking has an agent, and that it is something that happens.

(22) a. (i) What Anna's doing over there is she's thinking who she should invite to the party.

[10]The reader might detect acceptability or interpretive contrasts between the progressive and the simple tenses. We return to this when we discuss telicity, in section 2.3 in particular.

(ii) What Anna did over there is she thought who she should invite to the party.

b. (i) What's happening over there is Anna's thinking who she should invite to the party.

(ii) What happened over there was Anna thought who she should invite to the party.

The examples in (21a), (22a-i) and (22b-i) also bring out the possibility of using 'think + Q' in the progressive. The progressive is a natural option with activities and accomplishments, while being restricted with statives. In this respect, compare thought reports with knowledge reports with embedded questions, which minimally differ in the choice of the verb. These and other canonical statives do not pass these tests. (Being 'restricted' in the progressive corresponds to different intuitions. Example (23a) strikes speakers as unacceptable, while (23b) gives rise to the special interpretation that the subject's taste for Italian food is recently acquired.)

(23) a. #Anna's knowing who she should invite to the party. (improves with 'more and more often')

b. #Anna's loving Italian food. (improves with 'these days')

(24) a. (i) #What Anna's doing over there is she's knowing who she should invite to the party.

(ii) #What Anna's doing over there is she's loving Italian food.

b. (i) #What's happening over there is Anna's knowing who she should invite to the party.

(ii) #What's happening over there is Anna's loving Italian food.

The examples in (24) are mildly confounded and suffer, in fact, from a double penalty. As 'know' and 'love' do not easily occur in the progressive for independent reasons, the sentences may be unacceptable because of the progressive (rather than because knowing who and loving Italian food are not things that happen). The sentences in (25) show, however, that 'know' and 'love' are natural in the simple past, while the simple past pseudo-cleft constructions in (26) remain odd with these predicates.

(25) a. Anna knew who she should invite to the party.

b. Anna loved Italian food.

(26) a. (i) #What Anna did over there was she knew who she should invite to the party.

(ii) #What Anna did over there was she loved Italian food.

b. (i) #What happened over there was Anna knew who she should invite to the party.

(ii) #What happened over there was Anna loved Italian food.

Furthermore, 'think + Q' can be modified by agent-oriented adverbials like 'carefully' or 'intentionally' that do not straightforwardly modify stative eventuality descriptions. In the sets of sentences in (27), the unacceptability of simple past 'know' and 'love' with these adverbials suggests that the effect is independent of whether the verbs are acceptable in the progressive.

(27) a. (i) Anna was carefully thinking who she should invite to the party.
(ii) Anna carefully thought who she should invite to the party.
(iii) Anna was intentionally thinking who she should invite to the party.
(iv) Anna intentionally thought who she should invite to the party.

b. (i) #Anna was carefully knowing who she should invite to the party.
(ii) #Anna carefully knew who she should invite to the party.
(iii) #Anna was intentionally knowing who she should invite to the party.
(iv) #Anna intentionally knew who she should invite to the party.

c. (i) #Anna was carefully loving Italian food.
(ii) #Anna carefully loved Italian food.
(iii) #Anna was intentionally loving Italian food.
(iv) #Anna intentionally loved Italian food.

Finally 'think + Q' may occur as the complement of 'force' or 'persuade,' and it may occur in the imperative with a command interpretation.[11]

(28) a. (i) Chloe forced her to think who she should invite to the party.
(ii) #Chloe forced her to know who she should invite to the party.
(iii) #Chloe forced her to love Italian food.

b. (i) Chloe persuaded her to think who she should invite to the party.
(ii) #Chloe persuaded her to know who she should invite to the party.
(iii) #Chloe persuaded her to love Italian food.

c. (i) Think who you should invite to the party (before inviting them)!
(ii) #Know who you should invite to the party (before inviting them)!

[11] I specify 'command interpretation,' as statives also occur in the imperative, but with a different interpretation. *(Please) love Italian food!* might be a hope, for example, that one expresses before a first date. Thanks to Seth Cable here for discussion. The relationship between imperative form, meaning and stativity is discussed in Lakoff (1966). Lakoff shows, for example, that 'go imperatives,' e.g., *go wash your hands!* are unrescuably unacceptable with statives: *#Go love Italian food!* 'Think + Q' is fine here: *Go think who you should invite to the party!*

(iii)#Love Italian food!

Now, Levin (2009) warns that some of these tests—in particular, the force/persuade, agent-oriented adverbial and the imperative tests—diagnose agentivity in addition to dynamicity. Perhaps contrary to our intuitions about what it means to 'do' something, it is interesting to note about the 'do' pseudo-cleft construction that it is compatible with some non-agentive dynamic predicates as well, as shown by (29).

(29) What the rock did was roll down the hill. (Levin, 2009, ex. (31b))

From these sets of observations, we can conclude that 'think + Q' may be dynamic and agentive, as it passes all of the relevant tests. From the fact that 'know + Q' and 'love Italian food' fail the ones Levin warns about, we may only rigorously conclude that they are not agentive, but they could still lead a dynamic life that is non-agentive. Against this, and in favor of their stativity, we have that these predicates do not easily occur in the progressive, the 'happen' pseudo-cleft constructions and, depending on what one thinks about examples like (29), the 'do' pseudo-cleft constructions.

In sum, 'think + Q' patterns like a dynamic predicate with respect to the tests above, and contrasts with minimally different 'know + Q,' on the one hand, and a canonical non-attitude stative like 'love Italian food,' on the other. The contrast with 'know + Q' reveals that while embedded questions make it possible for 'think' to be dynamic (in fact, force it to be, as shown below), they do not make it possible for just any predicate to be dynamic—a point to return to.

2.2.2 'Think + Q' must be a dynamic eventuality description

The first piece of evidence that suggests that 'think + Q' must be dynamic, or, equivalently, that it cannot be stative, is that the construction does not occur in the present simple with an ongoing state interpretation.[12] It is difficult to describe what such an interpretation would look like because it does not exist, but a reasonable expectation is that a sentence like (30a) could have meant something along the lines of (30b) or (30c).

(30) a. #Anna thinks who she should invite to the party.
b. Anna has a thought about who she should invite to the party.
c. Anna knows who she should invite to the party.

[12]The possibility of heading an ECM complement to 'believe' or to 'seem' are sometimes cited as tests for stativity. These yield results similar to the present simple test discussed in the main text.

Both of the acceptable sentences are stative descriptions that compose with an embedded question, which introduce a belief relation that the attitude holder bears to one of the answers to the embedded question. This is a kind of reading that (30a) does not have. (We in fact expect that (30a) should mean (30b), given independently motivated assumptions about the meaning of attitude verbs and embedded questions.)

That is not to say that sentences like (30a) are ungrammatical or uninterpretable. They do receive a habitual or a sportscaster's present interpretation, as suggested by (31). (Dowty (1979: pp. 55–56) credits Kenny (1963) for this observation about the present. The present simple is also discussed in Bennett and Partee (1972), who point out the existence of a third kind of meaning, which I set aside. This is the futurate, as in *John arrives today*.)

(31) a. (i) Anna thinks who she should invite to her parties.[13]
(ii) Anna frequently thinks who she should invite to her party.
b. Anna walks in. She thinks who she should invite to her party. Figures it out. Walks out.

The availability of such interpretations reinforces the claim that 'think + Q' must be dynamic. Indeed, these are exactly the interpretations that dynamic predicates receive in the simple present. Observe, for example, (32):

(32) a. Anna runs a mile (every morning).
b. Anna walks in. She runs a mile. Walks out.

In particular, dynamic predicates do not have an ongoing event interpretation in the present simple. They do not mean what their present progressive counterparts mean. This is also true of 'think + Q.'

(33) a. #Anna runs a mile.
Does not mean: Anna is running a mile.
b. #Anna thinks who she should invite.
Does not mean: Anna is thinking who she should invite.

A second test for stativity is that statives in the simple past inserted in a narrative sequence are

[13]Thanks to Barbara Partee who suggested using the plural 'parties' in the embedded clause to favor a habitual interpretation without having to use adverbs.

able to provide background information, whereas non-statives advance narrative time (Deo to appear and references therein).[14] In (34), the second sentences in the sequences provide background information. One way of understanding this is that the interval of time at which the loving Italian food or the knowing what food I like holds extends beyond my walking in and Anna telling me something.

(34) a. I walked in. Anna loved Italian food. She told me to make a panino.
b. I walked in. Anna knew what food I should make. She told me to make a panino.

To substantiate our intuitions about this sequencing of events, we could try the following: In (35a), the 'since' modifier makes it clear that the state described by 'loved Italian food' precedes the walking in; In (35b), the anaphoric expression 'after that' sounds odd—compare with the same test in (36)—and to the extent that it may pick up an event, that must be the event of my walking in. Similar facts replicate for (34b).

(35) a. I walked in. Anna loved Italian food since her trip there. She told me to make a panino.
b. I walked in. Anna loved Italian food. #After that, she told me to make a panino.

In (36), however, the second sentences in the sequences describe something that happens after my walking in. 'Think + Q' reports in ths frame pattern like other dynamic eventuality descriptions and unlike statives: They move narrative time forward, rather than being able to provide background information as was the case in (34). 'After that,' in the third sentences may be anaphoric on the putting the phone down or the thinking, suggesting that the second sentences may be dynamic. That the 'think + Q' must be, in this frame, is illustrated in the next paragraph.

(36) a. I walked in. Anna put her phone down. (After that) she told me to make a panino.
b. I walked in. Anna thought what food I should make. (After that) she told me to make a panino.

The following pair make a similar point. The perfect in the third sentence forces reference to an event instantiated prior to the time of the walking in. While such an event can be recovered from 'know + Q,' this seems impossible with 'think + Q.'

(37) a. Anna walked in. She knew how much booch she should have. She had told me how

[14] Daniel Altshuler, p.c., points out that things are more complicated—they are.

much this morning.

b. Anna walked in. She thought how much booch she should have. #She had told me how much this morning.

It is useful to compare these sequences to their counterparts where 'know' and 'think' embed a declarative (we will take a closer look at 'think' with declaratives in section 2.2.4). Both of the sequences in (38) are felicitous, and in particular, (38b) contrasts with (37b), suggesting that 'think that' does have a stative guise, which 'think + Q' lacks.

(38) a. Anna walked in. She knew that she should have two gallons of booch. She had told me that number this morning.

b. Anna walked in. She thought that she should have two gallons of booch. She had told me that number this morning.

The unacceptability of the b. variant of (37) could be because in addition to sequencing events in a certain way, it also assumes that 'think' has the same understanding with questions as 'know,' namely that the attitude holder believes an answer to the question (which she could then tell). Examples that alleviate this worry are admittedly trickier to construct, but (39) is at least close to what we are after. Here too, the b. example with 'think' feels more contrived than the more natural a. example with 'be curious.'

(39) a. Anna walked in. She was curious whether Brutus had killed Caesar. She had asked me that this morning.

b. #Anna walked in. She thought whether Brutus had killed Caesar. She had asked me that this morning.

The behavior of 'think + Q' in the simple present and the simple past patterns with other dynamic descriptions rather than with statives. Unlike tests that disambiguate in favor of dynamic understandings, the tests discussed in this section would have let shine *think*'s stative guise with embedded questions if it had one—and they did not. I have otherwise been unable to find environments that allow or require dynamic predicates that disallow 'think + Q.' We are then in a position to conclude that 'think + Q' must be a dynamic eventuality description.

(40) **Generalization**:

When 'think' composes with a question, the resulting eventuality description must be dy-

namic.

In the preceding discussion, we have tried to disambiguate in favor of stative vs. non-stative understandings. There are also environments that are compatible with both stative and non-stative predicates. Two such examples are gerunds, and complements of 'want.' (The simple past is also one.)

(41) a. Knowing who you should invite is important before throwing a party.
b. Loving Italian food is important before traveling to Italy.
c. Running a mile is important before taking a shower.

(42) a. Anna wants to know who she should invite to the party.
b. Anna wants to love Italian food.
c. Anna wants to run a mile.

These are environments where 'think + Q' is able to occur, and where it patterns like a dynamic predicate. At the level of intuition, the examples in (43) say that before throwing a party, one should deliberate and that Anna wants to engage in a deliberative process. They are similar to the sentences with 'run' in (41) and (42), rather than to those with 'know' and 'love.'

(43) a. Thinking who you should invite is important before throwing a party.
b. Anna wants to think who she should invite.

This is as expected per the generalization stated in (40).

2.2.3 Evidence from Turkish and the case of French

If we find counterparts of English 'think + Q' in other languages, I conjecture that they will follow the generalization in (40). I will provide initial support for this conjecture based on a brief discussion of Turkish, as this kind of investigation requires an in depth understanding of the target language's tense aspect system. I will then turn to a comparison between English, Turkish and French. The case of French is interesting in that it reveals that placing a counterpart of 'think' (we will look at *penser*) in a frame where dynamic predicates are acceptable does not suffice to make the verb acceptable with question complements.

The Turkish predicate *düşün-*, 'think,' combines with declaratives and with questions alike. Comparing its behavior with *bil-*, 'believe/know,' we see that in the declarative case, they both pass a

stativity test for the language, but that their behavior comes apart in the question case. The pair of sentences in (44) is in the aorist, whose behavior parallels that of the English present simple in relevant respects. They are both able to describe an ongoing state with an embedded declarative.

(44) a. Anna [Brian'ı davet etmen gerektiğini] bil-ir.
Anna Brian.ACC invitation do.2S need BIL-AOR
Anna knows that you should invite Brian.

b. Anna [Brian'ı davet etmen gerektiğini] düşün-ür.
Anna Brian.ACC invitation do.2S need DÜŞÜN-AOR
Anna thinks that you should invite Brian.

The sentences in (45) minimally differ from the ones in (44) in that the embedded clause is now a question. Here, the sentence with *bil-* is able to describe an ongoing state. The sentence with *düşün-*, on the other hand, cannot. One prominent understanding that it has is as the habitual of an eventive predicate—as brought out, for example, by (45c). (The aorist is associated with a range of interpretations. Important here is that the ongoing state understanding is available in one case but not in the other.)

(45) a. Anna [kimi davet etmen gerektiğini] bil-ir.
Anna who.ACC invitation do.2s need BIL-AOR
Anna knows who you should invite.

b. #Anna [kimi davet etmen gerektiğini] düşün-ür.
Anna who.ACC invitation do.2s need DÜŞÜN-AOR
#Anna thinks who you should invite.

c. Anna [kimi davet etmen gerektiğini] sık sık düşün-ür.
Anna who.ACC invitation do.2s need frequently DÜŞÜN-AOR
Anna thinks who you should invite.

The difference between (45b) and the rest of the sentences in the paradigm is consistent with the behavior of other stative vs. non-stative predicates in the aorist. Observe, for example, the contrast in (46), which illustrates that *sev-*, 'like/love,' in the aorist is compatible with an ongoing state interpretation, but not *koş-*, 'run,' which is naturally understood as a habitual.

(46) a. Anna İtalyan mutfağını sev-er.
Anna Italian cuisine like-AOR
Anna likes Italian cuisine.

b. #Anna koş-ar.
Anna run-AOR
Anna runs.

This preliminary foray into the behavior of *düşün-* illustrates the kind of pattern that we expect to find if the generalization that 'think + Q' is dynamic holds cross-linguistically.

***

The reason that we have looked at the Turkish aorist, rather than the language's simpler present in *-Iyor*, is that both stative and dynamic predicates may occur in the latter form and give rise to ongoing state and event readings respectively.

(47) a. Anna İtalyan mutfağını sev-iyor.
Anna Italian cuisine like-PRES
Anna likes Italian cuisine.

b. Anna koş-uyor.
Anna run-PRES
Anna is running.

That is, this verb form does not allow us to disambiguate between stative and dynamic predicates. Notice in particular that (47a) translates an English present simple, and (47b), a present progressive. Consistent with our generalization, *düşün-* should be compatible with embedded questions in its *-Iyor* form (and give rise to a dynamic understanding).

(48) Anna [kimi davet etmen gerektiğini] düşün-üyor.
Anna who.ACC invitation do.2s need DÜŞÜN-PRES
Anna is thinking who you should invite.

In general, then, we might expect that if a language has a tense/aspect combination that is compatible with dynamic predicates, we will observe a counterpart of 'think' in that language acceptable with embedded questions in that tense/aspect combination. The French *présent simple* is one such combination:

(49) a. Anna aime la nourriture italienne.
Anna like.PRES the food Italian
Anna likes Italian food.

b. Anna court.
Anna run.PRES
Anna is running.

The verb *penser* is a counterpart of 'think.' Yet, the verb does not embed questions in the *présent simple*.

(50) *Anna pense qui elle devrait inviter.
Anna PENSER.PRES who she should invite
Int. Anna is thinking who she should invite.

French also has a way of disambiguating in favor of dynamic interpretations of predicates—the periphrastic progressive *être en train de* + infinitive.

(51) a. #Anna est en train d'aimer la nourriture italienne.
Int. Anna likes Italian food.
b. Anna est en train de courir.
Anna is running.

Penser does not seem to embed questions in this dedicated progressive form either:

(52) *Anna est en train de penser qui elle devrait inviter.
Int. Anna is thinking who she should invite.

Judgments improve with *penser* when the embedded question is introduced by the preposition *à* (which is distinct from the counterpart of 'about,' *à propos de*).

(53) ?Anna pense/est en train de penser à qui elle devrait inviter.
Anna is thinking who she should invite.

These sentences remain degraded compared with the ones in (54), with the verb *réfléchir*, which also requires a preposition.

(54) a. Anna réfléchit *(à) qui elle devrait inviter.
b. Anna est en train de réfléchir *(à) qui elle devrait inviter.
Anna is thinking who she should invite.

Interesting about *réfléchir* is that the verb does not combine with declaratives, and it is distinct from another rogative embedding strategy with *se demander* in that the former is dynamic, while the latter may be stative.

(55) a. *Anna réfléchit qu'elle devrait inviter Brian.
b. Anna se demande qui elle devrait inviter.

There are three main conclusions to draw from this discussion. First, the role of prepositions in enabling question embedding remains to be better understood. Second, about the distinction between *penser* and *réfléchir*, it might be that some languages have a dedicated strategy for expressing what we have been referring to as 'think + Q,' which makes use of a verb that is distinct from the one that is used to express declarative thought reports. This should not, however, deter us from trying to provide a unified account of 'think that' and 'think + Q' in English. One reason for this is that we also see, in language after language, the same root being used in both constructions. (We have seen Turkish *düşün-*. We look at Hindi, Mandarin, and Russian and Ukrainian in section 2.3.2 below.) Finally, French does not falsify the generalization that we have uncovered in this section. Rather, the case of French shows that satisfying the dynamicity condition might, in some cases, not be enough to observe a counterpart of 'think' composing with questions. We will also see a case where satisfying dynamicity is not enough in English, in section 5.1.[15]

2.2.4 'Think that' can be stative or dynamic

The difference between 'think + Q' and 'think that' is that 'think that' can be a stative eventuality description. The main piece of evidence for this claim comes from the possibility of using 'think that' in the present simple with an ongoing state interpretation. This is illustrated by (56), which has this interpretation.[16]

(56) Anna thinks that Brutus killed Caesar.

This makes 'think that' reports pattern like ones introduced by 'know' and 'believe' as well as other canonical statives like 'know Italian' and 'like snails,' and differently from predicates like 'bike' or 'read a book.'

(57) a. Anna knows/believes that Brutus killed Caesar.
b. Anna knows Italian/likes snails.
c. #Anna bikes/reads a book.

The second piece of evidence that suggests that 'think that' can be stative can also be used to show that it need not be. This is the narrative sequence test, where stative descriptions provide

[15] I have not shown, but we should, that the relevant examples with *penser à + Q* and *réfléchir à + Q* cannot be stative (=must be dynamic).

[16] 'Think that' is also acceptable in an ECM complement of 'believe,' as well as with 'seems,' under a non-habitual understanding, two tests which mirror the present simple test.

background information, while dynamic descriptions move narrative time forward. In (58), we see that the duration of Anna's thought may either include the time of her walking in or that the thinking may follow the walking in. The continuations in (59a) and (58b) are respectively meant to bring out the stative and the dynamic interpretations of the second sentence, while ruling out the other.

(58) Anna walked in. She thought that she should have 2 gallons of booch.

a. She had told me that this morning.

b. After thinking that, she poured herself a glass.

This kind of ambiguity is possible because the English simple past is compatible with stative as well as dynamic eventuality descriptions, where the former, as we have seen, provides background information and the latter, moves narrative time forward. 'Think that' is then expected to *occur* in the simple past regardless of whether it is stative or not, and we should be able to categorize the event description as stative or not depending on which interpretive effect(s) it gives rise to. Here, we observe optionality, and we must conclude that 'think that' is either ambiguous or not specified with respect to stativity.

This kind of optionality is not, to my knowledge, very common. Predicates do not usually alternate as easily in terms of whether they are stative or dynamic. Another one that I have been able to identify is 'remember,' illustrated in (59) in the frame from the previous example.

(59) Anna walked in. She remembered that she should have 2 gallons of booch.

a. She had told me that this morning.

b. After remembering that, she poured herself a glass.

The possibility of occurring in the simple present with an ongoing state interpretation and of providing background information in narrative sequences should suffice to show that 'think + that' *can* be stative—an otherwise uncontroversial claim. The dynamic guise associated with 'think + that,' already seen in (58), proves to be more elusive.

Let us begin by expressing some skepticism about the conclusion that because 'think that' is able to move narrative time forward, it is able to introduce a dynamic eventuality description. Observe, in (60), that other statives may advance narrative time forward as well, if they are read as inchoatives.

(60) a. Anna walked in. She (immediately) loved what Edgar had done with the place. She walked out.

b. Anna walked in. She (suddenly) knew what she had to do. She walked out.

Inchoative interpretations are often made more easily available with adverbs like 'immediately' or 'suddenly.' If the adverb were obligatory in (60), our conclusion that 'think that' may be dynamic would not necessarily be in danger—but it appears that the adverb is droppable. This leaves open the possibility that the interpretation observed in (58b) (and (59b)), with an advancement in narrative time, could be the inchoative of a stative description. Moreover, as we have shown that 'think that' does have a stative guise, and that statives can be inchoative, an inchoative interpretation of stative 'think that' should exist.

There are several observations that suggest that 'think that' may be a bona fide dynamic predicate. We have seen examples in section 2.1.1, which suggested that 'think + that' was compatible with adverbs like 'worriedly,' which diagnose eventive predicates (ex. (3)). One such example is given in (61), contrasting in acceptability with '#worriedly know that.'[17]

(61) a. John worriedly thought that Tom Cotton was the ideal presidential candidate for 2024.
b. #John worriedly knew that Tom Cotton was the ideal presidential candidate for 2024.

Some manner adverbs typically used to diagnose eventives are of dubious acceptability with 'think that.' 'Carefully' and 'intentionally' are odd, at least out of the blue. But note that just like it is possible to 'think worriedly that,' it is also possible to 'think out loud.'

(62) a. ??John carefully/intentionally thought that Tom Cotton was the ideal presidential candidate for 2024.
b. John thought out loud that Tom Cotton was the ideal presidential candidate for 2024.

A second observation that suggests that 'think that' may be dynamic is that it may occur in pseudocleft constructions, contrasting here again with more robustly stative predicates like 'know.'

(63) a. What John did was think that Tom Cotton would win.
b. ??What John did was know that Tom Cotton would win. [ameliorates if 'know' is interpreted as 'guess']

Third, we turn to the delicate issue of the progressive. An additional observation that suggests that 'think + that' may be a bona fide dynamic predicate is that it naturally occurs in the progressive.

[17]Thanks to Seth Cable here for showing me that some of these tests were main text, rather than footnote material.

(64) Anna is thinking that she should invite Brian.

Predicates that are more robustly stative do not pattern this way, as suggested by (65). And while there might be ways of improving sentences like (65), no such device is needed for (64), which is acceptable out of the blue.

(65) a. #Anna is knowing that she should invite Brian.
b. #Anna is believing that she should invite Brian.

However, we know that some statives do and in fact sometimes must occur in the progressive.[18] This happens when the state described holds in a temporary or accidental way, as illustrated by the contrast in (66). Indeed, it is not a fundamental property of my socks to be on the bed in the same way that it is a fundamental property of New Orleans to be at the mouth of the Mississippi. The possibility of the progressive seems to reflect this contrast, in some cases.

(66) a. My socks are lying/#lie on the bed.
b. New Orleans #is lying/lies at the mouth of the Mississippi. (Dowty, 1979)

It could then very well be that 'think + that' in the progressive is not genuinely dynamic but that it describes a state that holds temporarily or accidentally.

We can find evidence that progressive 'think + that' can be stative and that it can be dynamic. The following context is meant to bring out progressive 'think + that' under its stative guise. The set up is that the attitude holder is not engaged in any mental activity as they are busy with something else. Their background beliefs may still be reported by using a progressive, as shown in (67a). This report seems interchangeable in context with the simple past sentence in (67b).[19]

(67) Context: Esra told me that she couldn't come to the party because she would be traveling in Mexico. At the party, I'm busy making sure that everybody's picklebacks are constantly refilled. A knock on the door... It's Esra!

a. I was thinking that you were in Mexico.
b. I thought that you were in Mexico.

[18] See Kenny (1963) and my fn. (12) for the observation that some attitude reports that we would like to call stative also have the option of occurring in the progressive.

[19] Interestingly, such reports are also neg-raising. It is felicitous to say "I wasn't thinking that you were in town" and also "I didn't think that you were in town."

While the comparison is not minimal with (67), 'think + that' under its dynamic guise can be brought out with the following series of examples. In (68), 'think + that' seems to be describing an activity. Some temporal frame adverbials help to bring out this understanding (Bervoets, 2014, 2020).

(68) a. When I walked in, Anna was thinking that she was finally ready to part with her scoby.
b. I was thinking that I wanted to lie in bed all day when I realized that I could.

The way that the examples in (69) are meant to work is that the negated 'think + that' reports introduce an activity that the attitude holder is not engaged in at topic time. Example (69a) shows that it is possible to assert that one is not engaged in a 'think + that' activity at a given time even when the embedded proposition is part of their background beliefs. Example (69b) makes a similar point.

(69) a. Masha thinks that Marvin is cool, but she isn't thinking that Marvin is cool right now.
b. When Esra knocked, I wasn't thinking that she was in Mexico. (I was busy with something else.)

This discussion leads me to expect that the following sentences should be able to be true together in the context described in (67).

(70) Context: Same as (67). I think Esra's traveling in Mexico, and I'm busy pouring picklebacks.
a. When Esra knocked, I was thinking that she was in Mexico. [as background belief]
b. When Esra knocked, I wasn't thinking that she was in Mexico. [as activity]

To sum up, there is evidence to suggest that 'think + that' describes states as well as activities. This observation leads us to expand our generalization from section 2.2 as follows:

(71) **Generalization**:
a. When 'think' composes with a question, the resulting eventuality description must be dynamic. [from section 2.2]
b. When 'think composes with a declarative, the resulting eventuality description may be stative or it may be dynamic. [this section]

2.3 Generalization two: Deliberative if atelic, decisive if telic

I now turn to the effect of telicity on the interpretation of (dynamic) 'think + Q' reports.

Dynamic predicates can be telic or atelic. As illustrated in (72), it is possible for the same verb to alternate between a telic or an atelic description. Sometimes, the alternation is conditioned by the verb's arguments or modifiers:

(72) a. Anna drank booch for/*in an hour.
b. Anna drank the booch *for/in an hour.

In other cases, there seems to be genuine ambiguity. Whether the sentences in (72) are acceptable with 'for' or with 'in' is conditioned by the verb's object. The sentences in (73), from Kratzer (2002), are compatible with 'for' or with 'in,' without a detectable conditioning factor.

(73) a. The doctor examined the patient for/in an hour.
b. We cooked the egg in/for five minutes.
c. We milked the cow in/for ten minutes.
d. She cleaned the house in/for two hours. Kratzer (2002)

In this section, we will see that 'think + Q' has both telic and atelic uses and that telicity has a non-trivial effect on the interpretation of such reports, namely that when atelic, they describe a deliberative process, and that when telic, they describe a decision. The canonical contrast instantiating this generalization is given in (74).[20]

(74) a. Anna is thinking who she should invite.
→ Anna is deliberating about who she should invite.
b. It took Anna an hour to think who she should invite.
→ Anna has decided who she should invite.

We will then turn to uncovering finer-grained properties of this telicity alternation.

[20]Telicity might have effects other than the contrast reported here, in particular on the interpretation of quoted complements of 'think' and the availability of embedded inversion. I leave this for further research. Finally, telic frames seem to obviate the embedded modal effect (see sections 2.1.4 and 5.1).

2.3.1 The interpretation of telic and atelic 'think + Q'

Speakers report that both of the sentences in (75) are acceptable. Subexample (75a) suggests that 'think + Q' can be atelic, and subexample (75b), that it can be telic.

(75) a. Anna thought who she should invite for an hour.

b. It took Anna an hour to think who she should invite.

Three comments on this contrast are in order. First, while the test in (75a) is compatible with some statives (e.g., "Anna was available for an hour"), we have established in section 2.2 that 'think + Q' could not be stative—so in (75a) we are dealing with a dynamic atelic predicate. Second, there is an understanding of (75b) where a thinking process takes an hour to *begin*. This inchoative coercion is characteristic of atelic predicates in telic frames (e.g., "It took her an hour to run") and is not the relevant understanding of the sentence here.

Third, I use the 'take' test to disambiguate in favor of telic interpretations, rather than the more straightforward 'in' test. This is because speakers tend to reject 'think + Q' with 'in' adverbials, as reported in (76).[21]

(76) ??Anna thought who she should invite in an hour.

I am uncertain as to why the 'take' test and the 'in' test should give rise to a different result with 'think + Q,' and whether other predicates pattern similarly in being acceptable with the former and degraded with the latter. Predicates of variable telicity, e.g., 'examine the patient' (Kratzer, 2004), are acceptable with 'for,' with 'in' or with 'take.'

(77) a. Anna examined the patient for an hour.

b. (i) Anna examined the patient in an hour.

(ii) It took Anna an hour to examine the patient.

Comparing 'think + Q' with these predicates is informative, as the latter also alternate in telicity, while a difference in behavior with the 'take' vs. 'in' test might be suggesting that different kinds of telicity alternations exist.

It should suffice here to make sure that predicates inserted in the 'take' frame have to be telic.

[21] I was originally contrasting the 'take' test with the 'spend' test, as in "Anna spent an hour thinking who she should invite." I had overlooked the fact that the 'spend' test is compatible with telic predicates, merely bringing out their activity stage: "Anna spent an hour making a sandwhich" but not "#Anna made a sandwich for an hour."

Example (78) suggests that this is the case. When the predicate 'Anna run' is inserted in the 'take' frame, the resulting sentence is odd. While it is possible to interpret examples like (78) as inchoatives ('start running') or as involving a run that is (tacitly) bounded, these interpretations carry the mark of coercion and are characteristic of activity predicates forced into telicizing frames.

(78) #It took Anna an hour to run. (also: #Anna ran in an hour.)

Moreover, I show in section 2.3.2 that both the telicity alternation and a corresponding interpretive contrast discussed here replicate across languages that make use of a diversity of devices to bring out atelic and telic interpretations of predicates. As a consequence, that we have to use the 'take' frame in English without being able to use the 'in' frame does not seem to endanger my main point.[22]

In addition to finding both sentences in (75) acceptable, speakers report that there is an interpretive difference between the two sentences of the pair. (This was foreshadowed in section 2.1.4.) When the eventuality description is atelic, the meaning of the sentence can be loosely paraphrased by using 'think about,' 'wonder' or 'be curious.'

(79) Ex. (75a) ≈ Anna spent an hour thinking about who she should invite.

This meaning corresponds to a deliberative process the agent of which seeks an answer to the embedded question. This process does not necessarily terminate with a situation in which the agent has decided on or believes an answer. In support of this claim, observe that (75a) is compatible with a continuation that denies that a decision was reached about the answer.[23]

(80) Anna spent an hour thinking who she should invite, but she wasn't able to figure it out in the end.

For completeness, example (81) illustrates that atelic 'think + Q' reports are compatible with a decision being reached.

(81) Anna spent an hour thinking who she should invite, and/but she was able to figure it out in the end.

[22]It goes without saying that the subject 'it' in (78) should be read as an expletive and not as referring to an object of 'run,' like 'it (=the marathon) took Anna an hour to run.'

[23]There are examples like: "Anna spent an hour thinking who she should invite to the party, but she knew all along that it should be the psycholinguists and a couple of semanticists." These show that it might be possible to 'think Q' in a context where one already knows the answer to Q. My intuition here is that the thinking process and the prior commitment to an answer are operating on distinct levels of awareness.

When the eventuality description is telic, as in (75b), speakers report the intuition that the attitude holder has figured out or reached a conclusion about what the answer to the embedded question is. (It is clear that it does not suffice to form any belief about the answer to the question to make telic 'think + Q' reports true. That belief must in some sense correspond to a proposition true to the attitude holder.)

(82) Ex. (75b) ≈ It took Anna an hour to figure out who she should invite.

In example (83), telic 'think + Q' is followed up with the denial of the fact that an answer was reached. This sounds contradictory, suggesting that the decision inference associated with telic 'think + Q' is an entailment.

(83) #It took Anna an hour to think who she should invite, but she wasn't able to figure it out.

A further question is whether the decision inference is a semantic presupposition in addition to (or, instead of) being entailed. One characteristic difference between entailment and presupposition is that the former but not the latter can be targeted by certain sentence level operators like negation, question operators and non-veridical modals (Chierchia and McConnell-Ginet, 1990, a.o). For example, both of the sentences in (84a) entail that it is snowing. When the sentences are negated, in (84b), the inference that it is snowing persists with 'know,' but not with 'be right.' The inference, then, is an entailment of 'be right' and a presupposition of 'know.'

(84) a. (i) Anna is right that it's snowing.
Implies: It's snowing.
(ii) Anna knows that it's snowing.
Implies: It's snowing.
b. (i) Anna isn't right that it's snowing.
Does not imply: It's snowing.
(ii) Anna doesn't know that it's snowing.
Implies: It's snowing.

Because we are observing telic 'think + Q' and the decision inference in the derived environment created by the "it took Anna an hour to..." frame, it can be tricky to dissociate the inferences associated with 'think + Q' from the inferences associated with the frame. For example, (85a) conveys that Anna did decide who to invite. Can we conclude that the decision inference is a

presupposition? We cannot. In (85b), we see that both positive and negated 'take' sentences imply that the event described has culminated. This suggests that the culmination inference might be a presupposition of the frame, rather than the decision inference being a presupposition of 'think + Q.'

(85) a. It didn't take Anna an hour to think who she should invite.

b. (i) It took Anna an hour to examine the patient.
Implies: Anna examined the patient completely.

(ii) It didn't take Anna an hour to examine the patient.
Implies: Anna examined the patient completely (but that event did not last an hour).

As we will also see below, decisive 'think + Q' occurs in frames other than the 'take time' frame. Anticipating that discussion, the sentences in (86) involve decisive 'think + Q' embedded under a possibility modal 'can' that is questioned, in a., and negated, in b. These sentences are, respectively, a request to come up with an answer to the question of what the mirror reveals and the assertion that the speaker cannot come up with an answer to why Ruth left. That is, neither implies that the attitude holder has an opinion as to what the answer is.

(86) a. Can you think what the mirror of Erised shows us all?
[J.K. Rowling, *Harry Potter and the Sorcerer's Stone*]

b. I can't think why you left early, Ruth. [from *Columbo*]

The facts exemplified in (86) suggest that the decision inference associated with 'think + Q' is an entailment of the predicate, and not presupposed.

Putting these observations about telicity together, we obtain a second generalization—one that describes the effect of telicity on the interpretation of 'think + Q' reports.

(87) **Generalization**:

a. When 'think + Q' is atelic, it describes a deliberative process whose agent seeks to answer Q.

b. When 'think + Q' is telic, it describes a deliberative process whose agent seeks to answer Q and that culminates in a decision about the answer to Q.

Telic 'think + Q' in other environments The examples above made use of the 'it took x time to…' frame to bring out the decisive understanding associated with 'think + Q.' There are other frames that seem to have a similar effect in that they bring out a decision inference with 'think + Q.' For instance, the examples in (88) are understood as requests to come up with the answer, not as requests to deliberate.[24]

(88) a. Can you think what the mirror of Erised shows us all?
[J.K. Rowling, *Harry Potter and the Sorcerer's Stone*]

b. I can't think why you left early, Ruth. [from *Columbo*]

c. First, please think whether you need a Group or whether you can serve the same function with a Contact List of the people you need to communicate with.
[attested online]

It is unclear whether these frames necessarily bring out the decisive understanding of 'think + Q,' or whether they merely favor it. In general, when predicates that are obligatorily telic are placed in these frames, the question or the request bears on the completion of the event. Indeed, if I say

(89) a. Can you run a marathon?

b. Please run a marathon.

I am asking whether my addressee is able to complete a marathon, or I am requesting that they complete one. Atelic predicates may occur in these frames too, however, where the what is at issue is the process and not a completion (there is none).

(90) a. Can you run?

b. Please run.

Predicates that look genuinely ambiguous between telic and atelic, like 'milk this cow' (Kratzer, 2005), have the option of occurring as one or the other in frames like (89) and (90). The question and the request in (91) could bear on a completed milking event or a potentially incomplete process of milking depending on which understanding of the predicate is brought out.

(91) a. Can you milk this cow in an hour?

[24]There are also examples like *Think what your father would say!* (Seth Cable, p.c.) that do not involve a deliberative component but that are intuitively different from examples like (88). These can be paraphrased with 'figure out,' but Seth Cable's example cannot. The matter, which also calls into question the generality of the deliberative component hypothesized for telic 'think + Q' in (87b), deserves further thought.

b. Can you milk this cow for an hour?

(91) a. Please milk this cow in an hour.

b. Please milk this cow for an hour.

Because we are observing 'think + Q' in telic and atelic guises, the observation in (91) leads me to expect that it should be possible to bring out atelic 'think + Q' in these frames in addition to its telic use seen in (88). This expectation seems to be borne out for the imperative. The example in (92) is biased towards a request to deliberate, as the embedded question is a hard one.

(92) (For the rest of the hour) please think whether there is a God, creator of the universe.

For the 'can you think. . . ' frame, examples like (93) seem possible. Such a request is fulfilled if the addressee engages in a thinking even though they do not decide whether they will regret speaking up.

(93) Can you at least think whether you'll regret it before speaking up?

This use of 'can you think. . . ' is admittedly not a literal question about the addressee's abilities, as was the case in (88a) and I am unable to construct or to find atelic 'think + Q' under a questioned ability modal. Such a reading would receive the paraphrase marked 'unavailable' given in (94):

(94) Can you think what the mirror of Erised shows us?

a. Available: Are you able to figure out the answer?

b. Unavailable: Are you able to think about the answer?

An hypothesis about the unavailability of the intended reading is that it might be odd for pragmatic reasons to ask whether someone has the ability to engage in a mental activity—the answer presumably always being positive. A request to engage in such an activity, however, is not necessarily trivial in this way.

2.3.2 Cross-linguistic support for the telicity facts

In this section, I show that 'think + Q' alternates in telicity in a series of languages, and that this alternation correlates in the way described above with the availability of a deliberative vs. a decisive interpretation.

Russian and Ukrainian Russian has a verb *dumat'* that embeds both declaratives and questions. Example (95a) shows the declarative case, but we focus here on the deliberative and decisive interpretations of the question cases. Our starting point is example (95b).[25]

(95) a. Pëtr dumal čto on dolžen priglasit' Katju.
Pëtr think.IPFV.PST that he should invite Katia.ACC
Petr thought that he should invite Katia.

b. Pëtr dumal kogo on dolžen priglasit'.
Pëtr think.IPFV.PST who.ACC he should invite
Pëtr thought who he should invite.

In Russian, bare verb stems are said to be 'imperfective.' While Borik (2002) argues that Russian imperfective verbs may describe both telic and atelic eventualities, the felicity of 'dumal' with a 'for' adverbial and its infelicity with an 'in' adverbial, in (96), suggests that sentences like (95b) are atelic and do not have the option of being telic.

(96) a. Pëtr dumal dva časa kogo on dolžen priglasit'.
Pëtr think.IPFV.PST two hours who.ACC he should invite
Pëtr thought for two hours who he should invite.

b. #Pëtr dumal za dva časa kogo on dolžen priglasit'.
Pëtr think.IPFV.PST in two hours who.ACC he should invite
Intended, unavailable: It took Pëtr two hours to think who he should invite.
(Literally, "thought in two hours who")

Consistent with our observations about atelic question embedding thought reports in English, sentences like (95b) and (96a) are read as deliberative. One piece of evidence for this claim comes from the possibility of following them up with either the assertion that Pëtr was not able to reach a decision, in (97a), or that he was, in (97b).[26]

(97) a. ...No on ne mog rešit'.
but he NEG could decide
...But he wasn't able to decide.

b. ...I rešil priglasit' Katju.
and decide.PST.3S invite Katia.ACC

[25]I am indebted here to Tanya Bondarenko, Maria Privizentseva and Ekaterina Vostrikova Russian judgments and discussion, and to Khrystina Kunets for Ukrainian judgments and discussion. Daniel Altshuler and Paloma Jeretič have also provided valuable feedback.

[26]I am setting aside issues related to the exhaustivity of the answer given in (97b). We should, furthermore, be more thorough and show that (95b) has to be read as describing an activity and that the sentence implies that Pëtr is agnostic. There is a sense in which if this were not the case, the continuations in (97) would be odd. Indeed, they imply that the attitude holder was agnostic, and that they are doing something.

. . . And he decided to invite Katia.

(Both continuations acceptable after (95b) and (96a).)

Now, interesting about Russian is that it has a series of verbal prefixes that make 'imperfective' verbs 'perfective.' As I am unable to do justice to the rich and fascinating literature on Russian aspect, let us be satisfied with the observation that the past tense of two forms derived from *dumat'*, *pridumat'* and *nadumat'*, have to be telic.[27] Evidence is the infelicity of (98a) with a 'for' adverbial and the felicity of (98b) with an 'in' adverbial.

(98) a. #Pëtr pri-dumal/na-dumal dva časa kogo on dolžen priglasit'.
Pëtr PFV-think.PST/PFV-think.PST two hours who.ACC he should invite
Intended, unavailable: Pëtr thought for two hours who he should invite.

b. Pëtr pri-dumal/na-dumal za dva časa kogo on dolžen priglasit'.
Pëtr PFV-think.PST/PFV-think.PST in two hours who.ACC he should invite
It took Pëtr two hours to think who he should invite.

(Literally, "thought in two hours who")

And again, consistent with our observations about telic question embedding thought reports in English, reports with *pridumat'* and *nadumat'* are decisive. To wit, they sound contradictory with a follow up asserting that a decision has been reached. (I translate the sentence with 'figure out' to match the unacceptability of the English continuation with the unacceptability of the Russian continuation—similarly for Ukrainian, below.)

(99) Pëtr pri-dumal/na-dumal kogo on dolžen priglasit' #no on ne mog rešit'
Pëtr PFV-think.PST/PFV-think.PST who.ACC he should invite but he NEG could decide
kogo.
who.ACC
Pëtr figured out who he should invite, #but in the end he couldn't decide.

Further suggesting the cross-linguistic validity of these observations, I include in this section data from Ukrainian, which parallel the data that we have seen so far. Ukrainian has a verb *dymaty*, which is compatible with declaratives and with questions.

(100) a. Petro dumav šç vin maje zaprostyty Katju.
Petro think.IPFV.PST that he should invite Katja.ACC
Petro thought that she should invite Katja.

[27] I have not yet investigated which differences exist between these two forms, if any. Russian (and Ukrainian, below) also have secondary imperfectives formed off of perfective stems, *nadumyvat'* and *pridumyvat'*. The interpretive properties of secondary imperfectives of attitude verbs is a topic for further investigation.

b. Petro dumav koho vin maje zaprostyty.
Petro think.IPFV.PST who.ACC he should invite
Petro thought who he should invite.

When bare of any perfective suffixes and in the past tense, this verb introduces an atelic eventuality description, as evidenced by the felicity of the 'for' adverbial and the infelicity of the 'in' adverbial, in (101).

(101) a. Petro dumav dvi hodyny koho vin maje zaprostyty.
Petro think.IPFV.PST two hours who.ACC he should invite
Petro thought who he should invite for two hours.

b. #Petro dumav za dvi hodyny koho vin maje zaprostyty.
Petro think.IPFV.PST in two hours who.ACC he should invite
Intended, unavailable: It took Petro two hours to think who he should invite.
(Literally, "thought in two hours who")

Consistent with our observations, sentences like (100b) and (101a) describe a deliberation and they are compatible with the possibility that Petro does not decide on an answer to the embedded question. That is, the sentences are judged consistent with the continuation given in (102).

(102) ...Ale vin ne mih vyrishyty.
but he NEG could decide
...But he wasn't able to decide. (Acceptable after (100b) and (101a).)

The forms *nadymaty* and *prydymaty* are also available for this verb, which include perfective suffixes. These forms introduce telic descriptions, as they are compatible with 'in,' and incompatible with 'for,' as shown in (103).

(103) a. #Petro na-dumav/pry-dumav dvi hodyny koho vin maje zaprostyty.
Petro PFV-think.PST/PFV-think.PST two hours who.ACC he should invite
Intended, unavailable: Petro thought for two hours who he should invite.

b. Petro na-dumav/pry-dumav za dvi hodyny koho vin maje zaprostyty.
Petro PFV-think.PST/PFV-think.PST in two hours who.ACC he should invite
It took Petro two hours to think who he should invite.
(Literally, "thought in two hours who")

Finally, thought reports introduced by the telic *nadymaty* and *pridymaty* are decisive. Indeed, the continuation provided in (104) suggests that the thought report entails that a decision has been

reached.

(104) Petro na-dumav/pry-dumav koho vin maje zaprostyty. #Ale vin ne mih
Petro PFV-think.PST/PFV-think.PST who.ACC he should invite but he NEG could
vyrishyty.
decide
Petro figured out who he should invite. #But he wasn't able to decide.

Mandarin Mandarin has a verb *xiang* that embeds declaratives.[28]

(105) Wo xiang ta hui lai.
I XIANG 3S will come
I think she'll come tomorrow.

This verb also embeds questions. In this case, morphemes such as *dao*, marking resultative verb constructions, *zai*, an imperfective, or *guo*, a perfective, become obligatory. Their expression have the following interpretive effects: With *zai* and *guo*, the speakers that I have asked agree that 'xiang + Q' is deliberative. With *dao*, the meaning is decisive.[29]

(106) a. (i) Mali *(zai) xiang ta gai yaoqing shui.
Mary ZAI XIANG 3S should invite who
Mary is thinking who she should invite.

(ii) Mali xiang *(guo) ta gai yaoqing shui le.
Mary XIANG GUO 3S should invite who ASP
Mary thought who she should invite.

b. Mali xiang *(dao) ta gai yaoqing shui le.
Mary XIANG DAO 3S should invite who ASP
Mary figured out who she should invite.

Comments from consultants: "She has figured out an answer.""She had no idea who to go with. Now she picked someone and we don't know who."

For reasons of time, I have not been able to conduct the additional spot checks that are required here, namely, diagnosing more rigorously the aspectual properties of these constructions as well as the (un)availability of the deliberative and decisive interpretations. This initial look, however, suggests that Mandarin might be well-behaved with respect to our generalizations on dynamicity and telicity.

[28]Many thanks to Ang Li, who these data come from, and Yixiao Song and Rong Yin, who have provided additional judgments. All three note that declarative embedding under *xiang* appears to be restricted. Yixiao and Ang further note that in some cases, attitude reports formed with *xiang* are desiderative.

[29]I rely on my consultants for the judgment on the obligatoriness of these morphemes and on Klein et al. (2000) for their characterization.

Hindi Hindi has a root *soc* that is compatible both with declaratives and with questions.[30] The declarative case is illustrated in (107).

(107) Sakshi soc-tii hai ki use Brian=ko bulaa-naa caahiye
Sakshi SOC-IPFV.F be.PRS.SG that 3S.DAT Brian=DAT call-INF should
Sakshi thinks that she should invite Brian.

The Hindi imperfective is reported not to be compatible with ongoing event interpretations Deo (2006). Consistent with our observations about the obligatory dynamicity of 'think + Q,' we see in (108a) that *socnaa* is degraded with embedded questions in the imperfective, in (108a). More specifically, no ongoing event (or ongoing state) interpretation is available for these sentences, but it is possible to bring out a habitual interpretation by inserting, for example, temporal frequency adverbs. In contrast, (108b) shows that a verb like *janaa*, 'know,' is acceptable in the imperfective with an ongoing state interpretation.

(108) a. #Sakshi=ne soc-tii hai ki use kis=ko bulaa-naa caahiye
Sakshi=ERG SOC-IPFV be.PRS.SG that 3S.DAT who=DAT call-INF should
#Sakshi thinks who she should invite.

b. Sakshi=ne jan-tii hai ki use kis=ko bulaa-naa caahiye
Sakshi=ERG know-PFV be.PRES.SG that 3S.DAT who=DAT call-INF should
Sakshi knows who she should invite for an hour.

Comparing the imperfective with the progressive, which allows for ongoing event interpretations, we see in (109) that *soc* becomes acceptable with embedded questions and with the expected ongoing event interpretation.

(109) Sakshi=ne soc rahii hai ki use kis=ko bulaa-naa caahiye.
Sakshi=ERG SOC PROG.M be.PRES.SG that 3S.DAT who=DAT call-INF should
Sakshi is thinking/wondering who she should invite.

Interesting about '*soc* + Q' is that it is used to translate English 'wonder' reports (Rajesh Bhatt, p.c.). 'Wonder' differs from 'think + Q' in that it is acceptable in the present simple with an ongoing state interpretation. Hindi, it seems, only expresses the dynamic inquisitive attitude 'think + Q.'

Atelic and telic occurrences of *soc* with questions are presented next. In (110a), we have *soc* modified by 'for an hour,' and the continuation in (111b), which asserts that a decision has not been reached, is acceptable. ('Perfective' does not mean 'telic,' here.)

[30] Many thanks here to Rajesh Bhatt, for the data and discussion.

(110) a. Sakshi=ne (ek ghaṇṭe=tak) soc-aa ki use kis=ko bulaa-naa caahiye
Sakshi=ERG one hour=till SOC-PFV that 3S.DAT who=DAT call-INF should
Sakshi thought who she should invite for an hour.

b. lekin ant=meñ vo faislaa nahiiN kar paa-yii
but end=in 3S decision NEG do can-PFV.F
but in the end she couldn't decide.

In (111a), on the other hand, we have *soc* inserted in a frame, akin to the 'it took X time to Y' frame, which brings out the verb's telic understanding. Here, the assertion that a decision has been reached is a contradictory follow up.

(111) a. Sakshi=ne ek=hii ghaṇṭe=meñ soc li-yaa/nikaal-aa ki use
Sakshi=ERG one=only hour=in SOC take-PFV/take.out-PFV that 3S.DAT
kis=ko bulaa-naa caahiye
who=DAT call-INF should
In just one hour, Sakshi figured out (<*soc*) who she should invite.

b. #lekin ant=meñ vo faislaa nahiiñ kar paa-yii
but end=in 3S decision NEG do can-PFV.F
but in the end she couldn't decide.

2.3.3 The deliberative∼decisive alternation in the landscape of variable telicity

Variable telicity

In sections 2.3.1 and 2.3.2, we have seen ample evidence that 'think + Q' reports alternate in whether they describe a deliberation or a decision, and that this alternation in meaning is tied to whether we place 'think + Q' in an atelic or a telic frame.

Now, there are at least two kinds of atelic event descriptions: States, which we will set aside, and activities. And there are at least two kinds of telic event descriptions: Accomplishments and achievements. Example (112) illustrates predicates that fall under these categories, repeated from (23) in section 1.3.

(112) a. (i) Anna bottled the booch. [accomplishment, telic]
(ii) Anna bottled booch. [activity, atelic]
(iii) Anna noticed the scoby. [achievement, telic]
b. Anna knew Italian. [state, atelic]

There at least three ways that predicates *alternate* in telicity. First, there are cases like (113), where a canonically atelic predicate like 'run' may be interpreted as if it were telic.

(113) (Anna, a frequent marathon runner, was training.)
Yesterday, she ran in 2 hours 1 minute and 37 seconds. [telic]

These are standardly analyzed as instances of coercion, where the meaning of an eventuality predicate clashes with the requirements of the frame that it is inserted in and is then enriched, semantically or pragmatically, such that there is no clash. Here, the meaning of 'run' is enriched to describe a bounded eventuality and may then compose with the 'in' adverbial (Moens and Steedman, 1988).

Second, the examples in (112a-i) and (112a-ii) involve an alternation that is conditioned by the verb's internal argument (Krifka, 1989). The familiar tests in (114) substantiate this claim:

(114) a. Anna bottled the booch ?for/in an hour.
b. Anna bottled booch for/?in an hour.

Finally, the predicates illustrated in (115) are ambiguous or underspecified with respect to telicity. These predicates may be modified by 'for' or 'in' adverbials, respectively giving rise to an atelic or a telic understanding. Yet, there is nothing else that is visible in the sentences that is conditioning the alternation. Different from instances of coercion is that interpreting these predicates one way or the other does not require any effort.

(115) a. The doctor examined the patient in/for an hour. from Kratzer (2004)
b. We milked the cow in/for ten minutes. from Kratzer (2004)
c. I wiped the table. modified from Rothstein (2004)

In this section, I situate the deliberative∼decisive alternation that 'think + Q' exhibits within this broader landscape of telicity alternations.

The deliberative∼decisive alternation is not conditioned by the embedded clause

Telicity alternations exhibited by predicates like 'bottle the booch' vs. 'bottle booch' are conditioned by a verb's internal argument. In contrast, we observe no visible difference in *think*'s embedded question argument across the two alternants in the deliberative∼decisive alternation. In (116), the same VP, 'think who she should invite,' gives rise to an atelic or to a telic eventuality description.

The ‘for’ adverbial and the ‘take’ frame disambiguate.

(116) a. Anna thought who she should invite for an hour.

b. It took Anna an hour to think who she should invite.

This makes the deliberative∼decisive alternation look different from telicity alternations conditioned by verbs’ internal arguments.

However, embedded questions are sometimes analyzed as being able to denote different kinds of semantic objects. A variety of options exist here but, for concreteness, let the embedded question in (117a) denote a set of propositions and the one in (117b), a proposition derived from that set (Heim, 1994; Dayal, 1996, a.o.).

(117) a. Anna wonders who she should invite.

b. Anna knows who she should invite.

(≈ Anna knows that p, where p answers “Who should Anna invite?”)

Could the deliberative∼decisive alternation be conditioned, then, by similar shifts in the denotation of embedded questions?

These shifts in the denotation of embedded questions have been used to account for the fact that ‘know’ and ‘wonder’ give rise to different *attitude*-related entailments with embedded questions. Now, decisive ‘think + Q’ shares an entailment with ‘know + Q,’ namely that the attitude holder believes an answer to Q, and deliberative ‘think + Q’ shares entailments with ‘wonder + Q,’ namely that the attitude holder does not know the answer to Q and is curious about it. In this sense, differences between ‘know’ and ‘wonder’ are directly relevant to a successful analysis of the alternation at hand. If we choose to analyze them in terms of a difference in the denotation of their question complements, so is that difference.

These shifts in denotation have not, to my knowledge, been used to account for differences in the *aspectual* properties of attitude verbs (though see Rawlins 2013 and Zuchewicz 2020). Let us sketch out what such an account would look like for our telicity alternation: Sticking to the propositions vs. set of propositions denotations for embedded questions, a relationship needs to be established between being telic and taking a proposition as complement, and being atelic and taking a set of propositions as complement.

The first relationship does not seem to be motivated. Example (118) features ‘know’ and ‘realize’ with an embedded question complement that would have to be analyzed as a proposition (given our

assumptions) and a declarative complement, which also denotes a proposition.

(118) a. (i) Anna knows who she should invite. [atelic]
(ii) Anna knows that she should invite Brian. [atelic]
b. (i) Anna realized who she should invite. [telic]
(ii) Anna realized that she should invite Brian. [telic]

'Know' is an atelic predicate, while 'realize' is telic. This suggests that being telic or atelic is a property that is independent of taking a proposition as complement.

Of course, the fact that a verb undergoes telicity alternations conditioned by its internal argument depends on the verb: 'bottle booch/the booch' alternates while 'love' or 'notice booch/the booch' do not. The facts in (118) then leave open the possibility that there might be a link between being telic and taking a proposition as complement in the case of 'think.' Can we argue against *this* possibility? I believe that we can.

To do so, we need to make explicit the fact that embedded questions that we are assuming may denote propositions denote the same kind of objects as declaratives, which also denote propositions. (The point needs to be made indirectly here, as we do not observe atelic 'think' with a question entailing belief.) If the telic and decisive understanding of 'think' were linked to the fact that it takes a proposition as complement, examples like (119) would have to be telic, contrary to observation:

(119) Anna thought that Tom Cotton would win for a couple of minutes.

In sum, it does not seem like the deliberative∼decisive alternation that 'think' undergoes does not seem to be conditioned by overt or covert differences in the denotation of its question complement. In section 4, I will, however, pursue an analysis of the atelicity and the dynamicity of deliberative 'think' where these properties follow from a sets of propositions based analysis of embedded questions.

The atelic deliberative alternant is distinct: Compatibility with 'for' adverbials

A core observation to make about the alternation is that 'think + Q' admits a genuinely atelic interpretation.[31] That is, a view where 'think + Q' is unambiguously an accomplishment but where there are devices (e.g., the imperfective paradox in the progressive) that bring out that accomplishment's

[31] Aristotle, in *Metaphysics* (1048b), already categorizes νοέω, 'think,' as an atelic predicate. He is, however, talking about the predicate's intransitive use.

process stage—thus accounting for apparent activity interpretations—does not seem to be correct.

Let us substantiate this view, before setting it aside. In a phenomenon known as the 'imperfective paradox,' when an accomplishment predicate occurs in the progressive, we do not infer that the accomplishment has culminated and we are left with the process leading up to the culmination. For example, the culmination of crossing the street involves getting to the other side. When the predicate 'cross the street' occurs in the simple past, we infer that the event has culminated. When the predicate is in the progressive, we do not draw this inference. The contrast is illustrated in (120).

(120) a. Anna crossed the street #but she never got to the other side.
b. Anna was crossing the street ✓but she never got to the other side.

This leads to the following hypothesis about the meaning of 'think + Q' and the reason that it seems to alternate between deliberative and decisive uses.

(121) **Telic to activity** [to be set aside]
'Think + Q' denotes a telic eventuality description. Its activity uses are derived.

The main argument for the reality of an atelic interpretation comes from a test that we have already seen, namely the 'for' and 'in' test and the compatibility of 'think + Q' with 'for' adverbials. Importantly, 'for' adverbials are compatible with atelic predicates like activities, and incompatible with telic predicates like accomplishments and achievements.[32]

(122) a. (i) Anna ran for an hour.
(ii) #Anna ran to campus for an hour.
b. #Anna crossed the street for an hour.
c. (i) Anna drank beer for an hour.
(ii) #Anna drank a gallon of beer for an hour.
d. (i) #Anna noticed the red dot for an hour.
(ii) #Anna reached the summit for an hour.

This is so for accomplishments even though they introduce a process stage. While it is possible to bring out the process stage associated with the eventuality predicates that have them, e.g., in (123), this is not an option in the simple past with 'for.' The sentences marked '#' in (122) do not mean

[32]Dowty (1979) writes that accomplishments "only very marginally take adverbials with *for*."

that the subject engaged in that process for an hour.

(123) a. Anna was drinking a gallon of beer.
b. Anna was reaching the summit.

Consequently, if 'think + Q' were underlyingly telic, we would expect it to pattern like other telic predicates in being unacceptable with 'for' adverbials in the English simple past. But this expectation is not borne out:

(124) Anna thought whether she should invite Brian for an hour.

Further supporting the view that 'think + Q' has a distinct atelic reading is that it contrasts with attitude predicates like 'figure out,' which are incompatible with 'for' but compatible with 'in.' In contrast to 'think + Q,' these predicates pattern as if they were unambiguously telic.

(125) a. *Anna figured out whether she should invite Brian in an hour.
b. Anna figured out whether she should invite Brian in an hour.

On the telic decisive alternant

We have shown that the atelic uses of 'think + Q' do not necessarily correspond to the process stage of an accomplishment predicate, that 'think + Q' can be read as a genuine activity. We focus now on the telic guise(s) of 'think + Q.'

'Think + Q' also passes most of the familiar diagnostics for telic predicates. We have seen it used felicitously, for example, in the telic 'take' frame in which it gives rise to an inchoative and a decisive interpretation. The availability of the latter is what is suggestive of its accomplishment-hood.

(126) It took Anna an hour to think who she should invite.
a. Inchoative: It took her an hour to start thinking who she should invite.
b. Decisive: It took her an hour to decide who she should invite.

I have been unable to convince myself, however, of how robustly decisive interpretations of 'think + Q' are detected in contexts that do not force a predicate to be telic. For example, both activity and accomplishment predicates may occur in the simple past, with the difference that accomplishments typically give rise to the inference that the event described culminates. While the strength of this inference is reported to vary across different types of accomplishment predicates, it seems to be

drawn even in the weakest cases as long as there is no information to suggest that it should not be (Martin, 2019). The question then is whether a sentence like (127) is read as implying a culmination, namely, one where Anna has decided who to invite:

(127) Anna thought who she should invite.

It is clear that we will not be able to test for this inference by trying to set up a redundant or a contradictory continuation, as these can be avoided by interpreting 'think + Q' as an activity, which we saw was an option.

The second case to consider is the progressive. Here too, activities and accomplishments are both acceptable, but with the difference that accomplishments typically give rise to the imperfective paradox. That we are in its presence can be detected by the inference that if nothing unexpected happens, the event will culminate (what Portner 2011 calls the 'interruption principle').

(128) Anna is crossing the street.
$\rightsquigarrow$ Anna will get to the other side.

The question now becomes, does a sentence like (129a) imply that if nothing unexpected happens, Anna will reach a decision? For comparison, consider (129b) with telic 'figure out.' This sentence does clearly imply that Anna is making progress towards the answer.

(129) a. Anna is thinking who she should invite.
b. Anna is figuring out who she should invite.

The answer that Seth Cable (p.c.) gives to both of these questions is positive—that (127) and (129a) can be understood as culminating (if all goes as planned, for the latter). If we are to model the facts on the basis of these judgments, the deliberative$\sim$decisive alternation observed with 'think + Q' is no different from telicity alternations observed with predicates like 'milk the cow' or 'examine the patient.' What we learn about the latter from, for example, Kratzer (2004) may be used to understand the former.

If it turns out, however, that it is hard to access telic interpretations for 'think + Q,' or that these are most naturally available in frames that force predicates to be telic, one may explore an alternative view based on aspectual coercion. Notice, about coercion, that an atelic inquisitive predicate like 'wonder' only receives an inchoative interpretation in the 'take' frame. That is, while a sentence like (130) may mean that it took Anna an hour to start wondering, it cannot mean that it took her an

hour to reach a decision.

(130) It took Anna an hour to wonder who she should invite.

a. Inchoative: It took her an hour to start wondering who she should invite.

b. Decisive (unavailable): It took her an hour to decide who she should invite.

This situation contrasts with the behavior of 'think + Q' on two counts. One, the decisive interpretation is bounded to the right, not to the left. Two, a deliberation that is bounded to the right (that ends) need not be a decision.

A type of coercion that brings us closer to our goal is the complexive (Bary, 2009; Homer, 2019). This happens, in particular, when an atelic predicate is coerced into describing an eventuality bounded not just to the left but also to the right, as in (131), repeated from (113). See also Moens (1987) and Moens and Steedman (1988).

(131) (Anna, a frequent marathon runner, was training.)
Yesterday, she ran in 2 hours 1 minute and 37 seconds.

It is unclear, however, that using the complexive to bound 'think + Q' will immediately derive a culmination (as opposed to a termination). In sum, appealing to coercion is possible, provided that one proposes a novel kind of coercion tailored to fit the deliberative∼decisive interpretation.

I will not purse the matter further here, as settling how exactly the accomplishment reading of 'think + Q' arises does not bear on the rest of the dissertation, where we will be focusing on the alternation between the stative and the activity guises of 'think' (and its complement).

Two final remarks on deliberation vs. decision

First remark While we have covered a lot of ground concerning the aspectual and other interpretive properties of 'think + Q,' there remain a couple of examples worth mentioning that do not fit squarely with its deliberative or decisive guises. These are given in (132).

(132) a. I just thought what I wanna be when I grow up. Barbara Partee, p.c.

b. Think what your father would say! Seth Cable, p.c.

Example (132a) intuitively describes an achievement, involving an instantaneous change of state from agnosticism to belief without the mediation of a deliberative process. In fact, 'think' may be

replaced with 'realize' without an overall change in meaning. Barbara Partee's suggestion here is that the attitude holder might have had the question in mind and was thinking about it. This would let (132a) involve deliberation, although one that is not temporally contiguous with the decision. Alternatively, one may join Verkuyl (1993) in thinking that the difference between accomplishments and achievements resides in the duration of their process stage, that this may be short.

Seth Cable's example, in (132b) might involve yet another kind of meaning, as this example can neither be paraphrased as an order to deliberate and decide, or to bring about an instantaneous change of state. It is rather an order to *bear in mind* what the addressee's father would say.

What these uses of 'think + Q' have in common, with each other and with the decisive interpretations that we have been seing, is that they establish a relation between the attitude holder and a particular answer to the embedded question.

Second remark I have not said which verbs we expect to give rise to a deliberative∼decisive alternation and which verbs, not. I do believe, however, that we can formulate a reasonable hypothesis here based on the following intuition: The culmination of a decisive 'think + Q' is a 'think that p' eventuality where p is an answer to Q. 'Wonder,' on the other hand, does not embed declaratives and it could not culminate in any eventuality described by 'wonder that p.' This leads me to conjecture the following:

(133) **Conjecture**:
A verb V may give rise to a deliberative∼decisive alternation only if V is compatible with declarative complements.

This, in turn, leads us to expect that predicates like 'explore,' 'investigate,' 'be curious,' 'ask,' etc., which are compatible with questions but not with declaratives, will not give rise to decisive readings. (Speech predicates like 'ask' might not be possible candidates for other reasons.) While this conjecture does not say anything about which predicates *will* give rise to the alternation, we may notice that 'imagine' seems to, for example. For the sake of being explicit, I provide the relevant data here. Although the name of the alternation does not accurately represent our intuition about what it means to 'imagine + Q,' we see that in an atelic frame, the imaginer engages with more than one answer to Q, whereas in a telic frame, they have settled on one. Furthermore, the deliberative component of an imagining may be expressed by a bona fide activity predicate, as suggested by the 'for' test in (134a).

(134) a. Anna imagined for an hour who could've committed the murder.

b. It took Anna an hour to imagine who could've committed the murder.

It is also the case that 'imagine + Q' resists being stative much like 'think + Q,' as suggested by its unacceptability in the present simple, in (135a), under an ongoing state interpretation. Compare with the acceptable (135b), with a declarative.

(135) a. #Anna imagines who could've committed the murder.

b. Anna imagines that Sunniva could've committed the murder.

We may also ask whether verbs like 'remember' and 'figure out,' which also make available a process stage and a culmination, give rise to the same alternation, but in a slightly different form.

Chapter 3

Question embedding, neg-raising and aspect

In the previous section, I have argued that 'think' is not anti-rogative, that it is able to combine with embedded questions in addition to declaratives. Not everybody subscribes to this view, however. In fact, along with 'believe,' 'think' is often presented as a canonical anti-rogative and attempts are made to explain its alleged anti-rogativity.

In this section, I take a step back to talk about the place that 'think' occupies in classical work on the distribution of embedded clauses and to reflect on one explanation of its alleged anti-rogativity that has stood the test of time. This explanation draws on the old observation that all neg-raising predicates are anti-rogative (Zuber, 1982) and involves deriving both neg-raising and anti-rogative behavior from a common source, namely the excluded middle presupposition (Mayr, 2019; Theiler et al., 2019).

I then proceed to reassess this explanation. I couple the result, from the previous section, that 'think' with question complements is necessarily non-stative with the result, due to Xiang (2013) and Bervoets (2014, 2020), that the neg-raising inference is only observed with stative predicates, to argue that question embedding and neg-raising do exclude each other, but that the excluded middle presupposition does not cause anti-rogativity.

3.1 The Excluded Middle presupposition and anti-rogativity

3.1.1 Semantic properties of attitude reports explain the distribution of embedded clauses

A long-standing question in the literature on embedded clauses, embedded questions in particular, is how best to account for differences in their distribution. As the paradigm in (1) suggests, verbs that take sentential complements seem to fall into three categories depending on the type of sentential complement that they may take, that is, depending on whether they combine with declaratives and with questions, or only with one or the other. 'Responsives' like 'know' are generally able to embed declaratives as well as questions, 'rogatives' like 'wonder' are able to embed questions, but not declaratives, and 'anti-rogatives' like 'believe' are able to embed declaratives, but not questions.

(1) a. Anna knows that/whether she should invite Brian.
b. Anna wonders *that/whether she should invite Brian.
c. Anna believes that/*whether she should invite Brian.

Proposals about 'believe' are usually taken to extend to 'think,' at least on the basis of the apparent anti-rogativity of the latter and the fact that both predicates license the neg-raising inference, which I elaborate on below.

(2) Anna thinks that/*whether she should invite Brian.

This characterization of sentence embedding verbs as neatly falling into three categories is, of course, an idealization. Moreover, the potential effects of tense and aspect on question embedding are not discussed in the literature reviewed here, and I bracket their mention until section 3.3.1 below.

One kind of attempt at accounting for the paradigm in (1) relies on lexical selection at the level of syntactic or of semantic representations (see, for instance, the discussion in Grimshaw 1979). The gist of selection based accounts is to say that declaratives and questions correspond to objects of different syntactic categories or of different semantic types, and that verbs are lexically specified to be able to compose with one or the other. For responsives, which may compose with either, they have to be treated as underspecified or ambiguous, or ways of converting one type of clause into the other have to be devised.

There are two kinds of facts that weaken selection based accounts. First, there seem to be generalizations that govern whether verbs are responsive or anti-rogative. Both within a language

and across languages, for example, we find that verbs that are factive are responsive (like 'know') or verbs that are neg-raising are anti-rogative (like 'believe'). While these generalizations might have exceptions, they reveal that there is a deeper connection between semantic properties of attitude reports like factivity or neg-raising, and the possibility of embedding questions. Selection is unable to explain the facts or to make predictions here, as it amounts to specifying verbs' possible complement types on a case by case basis.

Second, some predicates alternate in their compatibility with declaratives or with questions depending on their environment. A predicate like 'be certain' is more acceptable with embedded questions when negated (Mayr, 2019; van Gessel et al., 2018) and a predicate like 'believe' becomes acceptable with embedded questions in certain frames, notoriously, under "can't" (Roberts, 2019).

(3) a. (i) ?Anna is certain whether it's raining.
(ii) Anna isn't certain whether it's raining.
b. (i) *Anna believes who ate the cake.
(ii) Anna couldn't believe who ate the cake.

Such alternations also seem to affect predicates that are canonically rogative, a possibility that has been brought to my attention by Satoshi Tomioka (p.c.) and that, to my knowledge, has not received much attention. In (4), taken from *Get Your Ass in the Water and Swim Like Me* (p. 37) by Bruce Jackson, 'wonder' is seen embedding a declarative.

(4) One doesn't wonder that the theme of black and white turns up in "Titanic," but rather that it turns up nowhere else in the toasts.

The existence of such alternations is unexpected from the perspective of selection: If a predicate is lexically specified to combine with declaratives but not with questions, or lexically specified to combine with questions but not with declaratives, the presence of negation or modals in the structure should not be able to relax this restriction. A proponent of selection might have to say, here, that these verbs are ambiguous between declarative and question selecting variants, and they would have to list (ideally, explain) the environments in which we find one variant versus the other.

In a tradition going back at least to Grimshaw (1979), accounts of the distribution of embedded clauses has thus aimed to minimize the role of selection, relying instead on independently observed semantic properties of attitude verbs and of sentences containing them. Even though Grimshaw is often cited for her argument in favor of semantic over syntactic selection, the kind of reasoning that

such accounts deploy is present in her paper, as the following example illustrates.

Exclamatives like (5a) may be embedded under certain predicates like 'know,' as shown in (5b).

(5) a. What a fool Bill is!
b. I know what a fool Bill is.

However, negating (5b) results in an unacceptable sentence, making it seem like negation blocks embedded exclamatives.

(6) #I don't know what a fool Bill is.

To account for the contrast between (5b) and (6), Grimshaw, citing Elliott (1971, 1974), points out that a root exclamative like (5a) presupposes that the speaker knows how much or what kind of a fool Bill is. This presupposition is consistent with the assertion in (5b) but contradictory with the one in (6). Here, the speaker presupposes that they know what kind of a fool Bill is while at the same time denying it—an odd thing to do. We thus explain what appears to be variation in the selection of embedded exclamatives in terms of independently motivated properties of exclamatives, the verb 'know,' and negation.[1] Moreover, we are now in a position to make a prediction. The hypothesized problem with (6) comes from the fact that we are attributing contradictory beliefs to the speaker. The sentence should then improve if the subject of 'know' is changed to a third person. And this is what we find, as shown by (7).

(7) Mary doesn't know what a fool Bill is.

The hope, then, is that we may let selection be unrestricted: In principle, 'know' is free to combine with exclamatives. And we explain cases where the combination is unacceptable in terms of the interaction of independently observed semantic properties, which also gives us predictive power. This is also the kind of reasoning that current approaches to question embedding make use of. That is what I turn to now.

[1] A question here is whether we expect (5b) to come out as redundant, if (6) comes out as contradictory.

3.1.2 The Excluded Middle presupposition explains the anti-rogativity of neg-raising predicates

Based on data like (8), 'think' and 'believe' are often taken to be anti-rogative predicates, acceptable with declaratives but not with questions.

(8) a. Anna believes that/*whether she should invite Brian.
b. Anna thinks that/*whether she should invite Brian.

Although we have been seeing that 'think' is acceptable with questions, it will be convenient to talk about it as an anti-rogative until section 3.3.1.

'Think' and 'believe' are also neg-raising predicates. This is a property of some sentence embedding predicates that makes it possible to interpret negation pronounced on the embedding predicate as if it were in an embedded clause. In other words, neg-raising predicates license the inference from subexample a. to subexample b. in (9) and (10).

(9) a. Kim doesn't believe that Travis has done his homework.
b. Kim believes that Travis hasn't done his homework.

(10) a. Kim doesn't think that Travis has done his homework.
b. Kim thinks that Travis hasn't done his homework.

A generalization attributed to Zuber (1982) links neg-raising and anti-rogativity, stating specifically that *all neg-raising predicates are anti-rogative*. Recently, Mayr (2019) and Theiler et al. (2019), whose proposal is foreshadowed in Egré (2008:fn. 3), account for this generalization by using three ingredients: First, an account of neg-raising in terms of a semantic excluded middle presupposition. Second, an existential semantics for embedded questions. And third, a hypothesis linking some logically trivial meanings and ungrammaticality. The first two ingredients assign a logically trivial meaning to 'think' and 'believe' composed with embedded questions, and the third ingredient rules out such constructions as ungrammatical—thus accounting for the anti-rogativity of 'think' and 'believe.'

Before moving on to the details of Mayr and Theiler et al.'s proposals, it is worth making a couple of remarks on neg-raising and Zuber's generalization. First, not all sentence embedding verbs are neg-raising. In the next two pairs of sentences, the inference from a. to b. does not go through, suggesting that 'know' and 'tell' are not neg-raising.

(11) a. Kim doesn't know that Travis has done his homework.
b. Kim knows that Travis hasn't done his homework.

(12) a. Kim didn't tell me that Travis had done his homework.
b. Kim told me that Travis hadn't done his homework.

Zuber's generalization is tacit about predicates that are not neg-raising, and indeed, we find some that are anti-rogative ('be right,' 'be true,' 'be false') and some that are responsive ('know,' 'tell'). The reader, however, is invited to consult Mayr (2019) for the behavior of predicates like 'be certain,' which are neither veridical nor neg-raising.

Second, while the neg-raising inference is perhaps preferentially drawn, it is not obligatorily drawn. In example (13), attributed to Bartsch (1973) and taken in simplified form from Gajewski (2005), we have a context where Peter lacks certain elements of Roman history and this makes him unopinionated as to whether Brutus murdered Caesar.

(13) **Context**: Peter has heard of Caesar and knows that he is a Roman general; Peter has also heard of Brutus as a Roman politician. He doesn't know, however, whether or not the two Romans lived at the same time. Both of the following are true:
a. Peter doesn't think that Brutus murdered Caesar.
b. Peter doesn't think that Brutus didn't murder Caesar.

Here, from an utterance of (13a) in the context given, we do not draw the neg-raising inference, namely, the inference that Peter thinks that Brutus didn't murder Caesar. If the neg-raising inference were obligatorily drawn, sentence (13a) would conflict with the contextual assumption that Peter does not know whether Brutus and Caesar have overlapped and examples (13a) and (13b) should certainly not be able to be true together. This and other cases where the neg-raising inference is not drawn will turn out to be crucial for evaluating Mayr and Theiler et al.'s proposals on the relationship between the excluded middle presupposition and anti-rogativity.

Finally, Zuber's generalization has not, to my knowledge, been challenged anywhere except in White (accepted). I will not be able to do full justice to White's paper here, as it has been evolving at the same time as this manuscript, but I propose a way of seeing some of the data that he presents *against* Zuber's generalization in a way that is *in line* with it in section 3.3.1.

1. Neg-raising, and the excluded middle presupposition

While there are several accounts of neg-raising in the literature, one that is influential, as well as crucial for Mayr and Theiler et al.'s proposals about the anti-rogativity of 'think' and 'believe,' involves the assumption that neg-raising predicates are lexically specified to encode a semantic Excluded Middle ('EM') presupposition. For a belief report of the form 'S believes p,' the EM presupposition takes the form 'S believes p or S believes ¬p.' This rules out the third ('middle') possibility that S is unopinionated with respect to p, that is, that they believe neither p nor ¬p. 'Believes,' here, can be replaced with the (for now) synonymous 'thinks' or other neg-raising predicates like 'want.' The derivation of neg-raising inferences as the result of a piece of reasoning that has the excluded middle as a premise goes back to Bartsch (1973). The idea that the excluded middle should be treated as a semantic presupposition rather than, say, a conversational assumption, is attributed to Heim (2000) and Gajewski (2005).

Example (14) illustrates with a positive thought report, where the EM presupposition is given in subexample a., and the sentence's assertion, in subexample b.

(14) "Kim thinks that Travis has done his homework"

a. defined only if Kim thinks that Travis has done his homework or Kim thinks that Travis has not done his homework
b. when defined, true iff Kim thinks that Travis has done his homework

In the positive case, the presupposition has no effect on the truth conditions of the sentence. When the sentence is defined, we may conjoin its presupposition with its assertion, and this is equivalent to its assertion ($[\mathrm{A} \vee \mathrm{B}] \wedge \mathrm{A} \equiv \mathrm{A}$).

In the negative case, however, the EM presupposition does have an effect on the truth conditions of the sentence—assuming that it projects past negation, like presuppositions regularly do. Example (15), which is a negated thought report, presupposes again that Kim has an opinion about whether Travis has done his homework but now denies that she thinks that he has.

(15) "Kim doesn't think that Travis has done his homework"

a. defined only if Kim thinks that Travis has done his homework or Kim thinks that Travis has not done his homework
b. when defined, true iff it is not the case that Kim thinks that Travis has done his homework

Informally, if Kim has an opinion but her opinion is not that Travis has done his homework, it must be that her opinion is that he has not. More formally, for the sentence to be defined and true, both its presupposition and its assertion must be true. Conjoining the two, we obtain that Kim thinks that Travis has not done his homework, as the sentence's assertion denies the first disjunct in the presupposition $([\mathrm{A} \vee \mathrm{B}] \wedge \neg \mathrm{A} \Rightarrow \mathrm{B})$. This derives the result that a negated belief report of the form "S doesn't believe p," when coupled with the EM presupposition, systematically entails that S believes ¬p (where one may change what needs to be changed for "think" and "want").

For predicates that are not neg-raising, it is standardly assumed, under this account, that they simply do not come with an EM presupposition. Consequently, the result of negating, e.g., 'Kim said that Travis has done his homework,' is that it is false that Kim said that Travis has done his homework, not that Kim said that Travis has not done his homework (which is consistent with our intuitions).

The account sketched out above makes it first appear like the neg-raising inference is obligatory with the class of neg-raising predicates, if we assume that presuppositions are not detachable from their triggers. But we have seen in (13), reiterated in (16), that the inference is optional. This sentence is understood to mean that Peter has no opinion about whether Brutus murdered Caesar.

(16) (Peter has no knowledge of Roman history so naturally...) he does not think that Brutus murdered Caesar.

Treating the EM as a presupposition leads us to expect that such sentences should trigger presupposition failure as the negated thought report is uttered against a background in which the presupposition is not satisfied. It follows from the context that Peter would not know whether Brutus killed Caesar or not, and this contradicts the EM presupposition that he believes that he did or that he did not. To handle such cases, it has to be that the EM presupposition is neutralized in one way or an other (either by not triggering it, or by triggering it and accommodating it under negation).[2]

2. An existential semantics for embedded questions

Attitude reports where a responsive predicate embeds a question typically give rise to meanings that can be paraphrased by replacing the question with certain declaratives, keeping the predicate constant. This is illustrated in (17).[3]

[2]See Collins (2020) for the observation that the excluded middle presupposition patterns differently from other semantic presuppositions in its projective behavior—that is, in the conditions that it imposes on the global context.

[3]Not all responsive predicates allow for this substitution: See at least Elliott et al. (2017) for predicates of relevance like 'care,' Roberts (2018) for Estonian 'mõtlema,' and this dissertation, section 4.2, for (deliberative) 'think.' This kind of substi-

(17) a. Kim knows whether Brutus killed Caesar.

b. If Brutus killed Caesar, Kim knows that Brutus killed Caesar, if Brutus didn't kill Caesar, Kim knows that Brutus didn't kill Caesar.

(18) a. Kim and Travis agree on whether Brutus killed Caesar.

b. Kim and Travis either agree that Brutus killed Caesar or they agree that Brutus didn't kill Caesar.

The declaratives that can felicitously replace questions in this frame are its answers. A question like "Did Brutus kill Caesar?" (or, in embedded form, "whether Brutus killed Caesar") admits two answers, namely that he did and that he did not.[4]

With a non-veridical predicate like 'agree,' the entailment is that there is an answer that the subjects agree on. That is, (18a) can be given a slightly more formal paraphrase as follows—disregarding the presuppositions of 'agree' (Spector and Egré, 2015).

(19) a. There is an answer p to the question whether Brutus killed Caesar s.t. Kim and Travis agree that p.

b. $\exists \mathrm{p} \in \{\mathrm{kill}(\mathrm{b},\mathrm{c}), \neg\mathrm{kill}(\mathrm{b},\mathrm{c})\} : \mathrm{agree}(\mathrm{k}+\mathrm{t},\mathrm{p})$

With veridical predicates like 'know' (analyzed as 'believe truly') the answer must also be true. This results in the following approximation for the truth conditions associated with (17a).

(20) a. There is an answer p to the question whether Brutus killed Caesar s.t. p is true and Kim and Travis believe that p.

b. $\exists \mathrm{p} \in \{\mathrm{kill}(\mathrm{b},\mathrm{c}), \neg\mathrm{kill}(\mathrm{b},\mathrm{c})\} : \mathrm{p} \wedge \mathrm{believe}(\mathrm{k}+\mathrm{t},\mathrm{p})$

If it is acknowledged that there are question embedding predicates that relate their subjects to potential (not necessarily true) answers to the question that they embed, like 'agree,' it is reasonable to assume that embedded questions may introduce (something equivalent to) existential quantification over their answer sets. The particular implementation of this idea differs, however, from author to author (Lahiri, 2002; Spector and Egré, 2015; Mayr, 2019; Theiler et al., 2019).

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tution does not make immediate sense for rogatives like 'wonder,' as they are not usually compatible with declaratives. See, however, Theiler et al. (2019) and Roelofsen and Uegaki (2020) where rogatives are composed with declarative denotations at abstract levels of representation.

[4]The notion of an answer is a complex one (Groenendijk and Stokhof, 1984). We will set aside answers like 'maybe,' that can be used to respond to polar questions in discourse but that will not feature in our alternative sets. We will also commit to bipolar (cf. monopolar) analyses of polar questions, following the literature presented here. Thanks to María Biezma and Kristine Yu for discussion.

3. Putting together neg-raising and an existential semantics for questions

Let us first take a look at the expected truth conditions for non-neg-raising and non-veridical belief predicates when they embed a polar question. A predicate that fits the bill is often thought to be 'be certain' (bracketing the observation that it is most acceptable with embedded questions when negated). These are stated in (21). They simply say that there is a proposition p that answers the question whether Brutus killed Caesar such that Kim believes p. The reader should not be thrown off by the fact that 'be certain' is represented in the metalanguage with the predicate 'believe' (Mayr, 2019; Theiler et al., 2019). We are thinking of 'be certain' as entailing belief without introducing the excluded middle presupposition (and abstracting away from aspects of its meaning pertaining to confidence in that belief).[5]

(21) a. ?Kim is certain whether Brutus killed Caesar.

b. true iff

$\exists \mathrm{p} \in \{\mathrm{kill}(\mathrm{b},\mathrm{c}), \neg\mathrm{kill}(\mathrm{b},\mathrm{c})\} : \mathrm{believe}(\mathrm{k},\mathrm{p})$

Adding the excluded middle presupposition into the derivation gives us the truth and definedness conditions for the belief sentence in (22). These correspond to the meaning of 'believe' when it embeds questions, which differs minimally from the meaning of 'be certain' in that 'believe' triggers the EM presupposition. The truth conditions here do not differ from the ones in (21). What is added, however, is the presupposition that for either answer p to the question, the subject either believes p or $\neg\mathrm{p}$. I write this presupposition in full, expand, and then simplify it using familiar equivalences for $\vee$ and $\exists$. It then appears that the presupposition and the assertion of the sentence are equivalent, namely, they are that Kim believes an answer to the question.[6]

(22) a. *Kim believes whether Brutus killed Caesar.

b. true iff

$\exists \mathrm{p} \in \{\mathrm{kill}(\mathrm{b},\mathrm{c}), \neg\mathrm{kill}(\mathrm{b},\mathrm{c})\} : \mathrm{believe}(\mathrm{k},\mathrm{p})$

c. defined only if

$\exists \mathrm{p} \in \{\mathrm{kill}(\mathrm{b},\mathrm{c}), \neg\mathrm{kill}(\mathrm{b},\mathrm{c})\} : \mathrm{believe}(\mathrm{k},\mathrm{p}) \vee \mathrm{believe}(\mathrm{k},\neg\mathrm{p})$

$\Leftrightarrow [\mathrm{believe}(\mathrm{k},\mathrm{kill}(\mathrm{b},\mathrm{c})) \vee \mathrm{believe}(\mathrm{k},\neg\mathrm{kill}(\mathrm{b},\mathrm{c}))]\vee$

[5] In this section, the reader will observe that I provide interpretations for sentences marked unacceptable. The reason it makes sense to do this is that the (un)acceptability of these sentences is calculated on the basis of the output of interpretation.

[6] I do not go into how these truth and definedness conditions are derived compositionally or into thorny issues relating to presupposition projection. The interested reader will find the discussion in Mayr (2019) useful. For us, it suffices to form an intuition about the end result of the derivation—a trivial meaning—and how this is linked to ungrammaticality.

$$[\text{believe}(\text{k}, \neg\text{kill}(\text{b}, \text{c})) \vee \text{believe}(\text{k}, \text{kill}(\text{b}, \text{c}))]$$

$$\Leftrightarrow \text{believe}(\text{k}, \text{kill}(\text{b}, \text{c})) \vee \text{believe}(\text{k}, \neg\text{kill}(\text{b}, \text{c}))$$

$$\Leftrightarrow \exists \text{p} \in \{\text{kill}(\text{b}, \text{c}), \neg\text{kill}(\text{b}, \text{c})\} : \text{believe}(\text{k}, \text{p})$$

What this means is that the interpretation function, when given a sentence like (22a), returns true or false only in contexts where the subject believes p or not p. But in those contexts, the assertion is that the subject believes p or not p. Hence, there is no way for the interpretation function to return false. The sentence, then, is true whenever it is defined.[7]

The overall result is unaffected by negating the embedding predicate, provided that negation scopes above the existential introduced by the question,[8] *and* provided that the presupposition projects past negation. This case is briefly illustrated in (23):

(23) a. *Kim doesn't believe whether Brutus killed Caesar.

b. true iff

$$\neg\exists \text{p} \in \{\text{kill}(\text{b}, \text{c}) \vee \neg\text{kill}(\text{b}, \text{c})\} : \text{believe}(\text{k}, \text{p})$$

c. defined only if [=(22c)]

$$\exists \text{p} \in \{\text{kill}(\text{b}, \text{c}), \neg\text{kill}(\text{b}, \text{c})\} : \text{believe}(\text{k}, \text{p})$$

Again restricting our attention to those contexts where the subject believes that p or that not p, we are asked to evaluate the statement that the subject believes neither p nor not p. This statement is false in those worlds. When defined, then, the sentence is (24) is false.

4. L-analycity

Given our assumptions about the excluded middle presupposition and the semantics of embedded questions, composing 'believe' with an embedded question gives rise to a tautology—in other words, a logically trivial meaning. What remains to be established is a link between logical triviality and ungrammaticality.

There are many sentences that have or are expected to have trivial meanings. Some might be odd things to say, e.g., (24a), but some are perfectly reasonable things to say, e.g., (24b).

(24) a. It's raining or it's not raining.

[7] It is interesting to note that Zuber (1982), via Egré (2008), originally makes use of the neg-raising inference to derive *contradictory*, rather than tautologous, truth conditions for 'believe whether.'

[8] If the question is interpreted as a quantifier that takes scope via QR, the question of why it must scope under negation arises. However, Mayr and Theiler et al.'s proposals do not literally interpret the question as a quantifier, which allows us to circumvent this issue without stipulation.

b. War is war.

Yet, similar sentences are not ungrammatical, contrary to what we want to derive for 'believe' with an embedded question.

It is useful to think about sentences with trivial meanings as ones that are true or false solely on the basis of their form. For instance, "it's raining or it's not raining" is true because of the meaning of the connective "or" and the fact that it disjoins a sentence and the negation of that same sentence. That the sentences being disjoined are "it's raining" and "it's not raining" does not matter. This contrasts with sentences whose truth or falsity depends on the state of the world. For instance, to determine whether the sentence "it's raining" is true, it will not suffice to look at the sentence—one has to look out of the window.

Within the class of sentences that have trivial meanings, Gajewski (2002) proposes that there is a kind of triviality, namely 'L(ogical)-analycity,' that *is* linked to ungrammaticality. The link is achieved by means of the following principle:

(25) A sentence is ungrammatical if its logical form contains an L-analytic constituent.

We now have to say what it means for a constituent to be L-analytic. It is intuitive to define L-analytic constituents procedurally. We first take a constituent and identify all of the logical and non-logical vocabulary items that it contains. Then, keeping the logical vocabulary unchanged, we replace the non-logical vocabulary items with arbitrary constants of the same type. If the interpretation of the resulting object remains trivial, the constituent is L-analytic.

To calculate whether a given constituent is L-analytic in a non-arbitrary way, we need a criterion for deciding which pieces of vocabulary count as logical and which do not. Gajewski proposes to make use of van Benthem's (1989) criterion, which requires that, for an expression to count as logical, its meaning must be insensitive to permutations defined on the domain of individuals. The reader is encouraged to consult the papers cited for further details. It suffices to note here that predicates like 'tree' come out as non-logical vocabulary and sentential connectives like 'or' and 'not,' whose meaning does not reference individuals, come out as logical.

Consider now the sentence (26a), repeated from (24a). The procedure outlined above amounts to filling in the gaps in (26b) with any arbitrary (sub)sentence and checking whether the meaning remains trivial, e.g., as in (26c).

(26) a. It's raining or it's not raining.

b. _____ or [not _____]

c. Mary's throwing a party or Brutus didn't murder Caesar.

While (26c) remains an odd thing to say, this disjunction is no longer necessarily true. It could be that Mary's not throwing a party and that Brutus did murder Caesar (while it cannot both be the case that it is raining and that it is not). Hence, (26a) is not filtered out as ungrammatical by the principle in (25).

A kind of sentence that (25) is taken to rule out is given in (27a), cf. (27b).

(27) a. *There is every tree.

b. There is a tree.

Take the customary semantics for the determiners 'every' and 'a' in (28a) and the semantics of the existential construction, in (28b), to be a predicate true of E, the domain of entities.

(28) a. (i) $[\![\text{every}]\!] = \lambda \text{P}_{\text{et}} \lambda \text{Q}_{\text{et}} . \forall \text{x} : \text{Px} \rightarrow \text{Qx}$

(ii) $[\![\text{a}]\!] = \lambda \text{P}_{\text{et}} \lambda \text{Q}_{\text{et}} . \exists \text{x} : \text{Px} \wedge \text{Qx}$

b. $[\![\text{There is...}]\!] = \lambda \text{R}_{\text{et,t}} . \text{R}(\text{E})$

Saturating the first argument of the quantifiers with the predicate "tree" and using this to saturate the argument of the existential construction, the meanings of "there is every tree" and "there is a tree" come out to be:

(29) a. $\forall \text{x} : \text{tree}(\text{x}) \rightarrow \text{x} \in \text{E}$

b. $\exists \text{x} : \text{tree}(\text{x}) \wedge \text{x} \in \text{E}$

It is 'easy' to see that (29b) can be true (if there are trees) or false (if there are no trees). However, (29a) cannot be false as long as there are things in E. Indeed, if there are trees, the implication is true, and if there are no trees, the implication is still true (because the antecedent is false). Now, if the only non-logical piece of vocabulary in (27a) is assumed to be 'tree,' we only look at filling in the gap in (30) with an arbitrary predicate of type et.

(30) There is every _____

But regardless of the predicate we pick, (29a) will evaluate to true. The sentence then contains an L-analytical constituent (itself), and it is ruled out as ungrammatical by the principle in (25).

It is important to further observe that structures whose ungrammaticality is attributed to L-analycity cannot be saved by further embedding (although they can be quoted much like any other string, grammatical or not). Some cases of embedding will conserve triviality. For example, negating the tautologous truth conditions of 'There is every tree' from (29a), given in (31), results in a contradiction. One way of seeing this is that predicates like 'tree' apply to individuals in E—hence, nothing can be a tree and not be in E.

(31) *There isn't every tree.

$$\begin{aligned} & \neg\forall \mathrm{x} : \mathrm{tree}(\mathrm{x}) \rightarrow \mathrm{x} \in \mathrm{E} \\ \equiv \quad & \exists \mathrm{x} : \neg[\mathrm{tree}(\mathrm{x}) \rightarrow \mathrm{x} \in \mathrm{E}] \\ \equiv \quad & \exists \mathrm{x} : \mathrm{tree}(\mathrm{x}) \wedge \mathrm{x} \notin \mathrm{E} \end{aligned}$$

Some cases of embedding do not conserve triviality. For example, while a proposition might be tautologous, there is nothing logically trivial in ascribing a tautological belief to someone, as in the attempt to do so in (32). Yet, these sentences remain ungrammatical.

(32) *Travis believes that there is every tree.

Case where L-analytic constituents are embedded and where ungrammaticality remains is captured by the principle in (25) because it suffices for a sentence to *contain* an L-analytic constituent to be ruled out as ungrammatical. One may, of course, argue whether this is empirically or theoretically satisfying.

5. Deriving '*believe wh-'

We have already shown that the truth conditions associated with 'believe wh-'/'think wh-' were tautologous. To derive ungrammaticality from tautology here, we need sentences like (33) to be L-analytic, in addition to being tautologies or contradictions.

(33) a. *Kim believes whether Travis has done his homework.
b. *Kim doesn't believe whether Travis has done his homework.

The main question to address here is this: To calculate L-analyticity, we look at the persistence of triviality under arbitrary substitutions of all non-logical vocabulary items in a sentence. The element in such sentences that gives rise to trivial truth conditions is the excluded middle presupposition

associated with particular lexical items like 'believe.' If we count 'believe' as non-logical vocabulary, we should replace it with an arbitrarily chosen relation of type st, et (or analogous). If we happened to pick a relation that does not encode the excluded middle presupposition, e.g., 'be certain,' we would not end up with trivial truth conditions. Consequently, the sentence would not be L-analytical and its ungrammaticality would not be able to be attributed to L-analycity.

Mayr and Theiler et al. propose to resolve this tension not by assuming that 'believe' is part of the logical vocabulary, but by assuming that at least some neg-raising attitude verbs may be decomposed into the components in (34). I have lowered the propositional type from the inquisitive semanticists' stt to st.

(34) a. $[\![\mathrm{base}_{\mathrm{believe}}]\!] = \lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{w}_{\mathrm{s}}.\mathrm{dox}(\mathrm{x}, \mathrm{w})$

b. $[\![\mathrm{R}_{\mathrm{EM}}]\!] = \lambda \mathrm{B}_{\mathrm{esst}} \lambda \mathrm{p}_{\mathrm{st}} \lambda \mathrm{x}_{\mathrm{e}} : \mathrm{B}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{p} \vee \mathrm{B}(\mathrm{x}, \mathrm{w}) \subseteq \neg \mathrm{p}.\mathrm{B}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{p}$

c. $[\![\text{believe}]\!] = [\![\mathrm{R}_{\mathrm{EM}}]\!]([\![\mathrm{base}_{\mathrm{believe}}]\!])$
$= \lambda \mathrm{p}_{\mathrm{st}} \lambda \mathrm{x} \lambda \mathrm{w} : \mathrm{dox}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{p} \vee \mathrm{dox}(\mathrm{x}, \mathrm{w}) \subseteq \neg \mathrm{p}.\mathrm{dox}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{p}$

Here, '$\mathrm{base}_{\mathrm{believe}}$' provides a doxastic modal base and R_{EM} is a morpheme that takes a modal base, introduces an excluded middle presupposition and turns the modal base into an attitude verb, as shown in (34c). (The particular choice of a doxastic modal base does not matter here, any modal base would do given the definition of (34b).) This is an object that is looking for a proposition and an individual and that relates them like 'believe' usually does. The assumption here is that while 'base' is not part of the logical vocabulary, R_{EM} is. In calculating whether an attitude report containing 'believe' is L-analytic or not, we are not allowed to vary R_{EM}—which is what gives rise to triviality with embedded questions.[9]

We are now ready to recast and refine Zuber's generalization, which we started this section out with. While this generalization stated that all neg-raising predicates were anti-rogative, we now have that the solution to the '*believe wh-' puzzle takes the semantic excluded middle presupposition to cause anti-rogativity. This is formulated in (35).

(35) **Thesis T1**

semantic excluded middle presupposition $\rightarrow$ anti-rogativity

"For any sentence embedding predicate P, if P is associated with the excluded middle, P does not embed questions."

[9] We are not allowed to turn the embedded question into an embedded declarative either, as this would give rise to non-trivial truth conditions. This is achieved by assuming that the question operator is also part of the logical vocabulary.

3.2 Neutralizing presuppositions

3.2.1 Non-triggering and local accommodation

As we have already seen in (13) and (16), the neg-raising inference is robust, but there are cases where it is not drawn. Bartsch's (1973) original example goes as follows (via Gajewski 2005):

(36) "Peter has heard of Caesar and knows that he is a Roman general; Peter has also heard of Brutus as a Roman politician. He doesn't know, however, whether or not the two Romans lived at the same time. It is clear then that (a) Peter does not think that Brutus murdered Caesar. Peter also cannot contradict anyone who asserts that Brutus didn't murder Caesar. But from this one cannot naturally conclude that Peter agrees with him in his judgment about what passed between Caesar and Brutus."

In these kinds of examples, the context makes it clear that the attitude holder is unopinionated about the truth of the embedded proposition. If the neg-raising inference associated with sentences with "doesn't think" is still active, asserting them in such contexts should give rise to a contradiction. This is, however, not what we observe and we conclude that the neg-raising inference is not necessarily drawn from sentences that, in other circumstances, do come with it.

Because it is the excluded middle presupposition that gives rise to the neg-raising inference, it is reasonable to think that at least in the cases where the neg-raising inference is not observed, the excluded middle presupposition is not operative either.

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There are two logical possibilities as to how presuppositions can go missing. The presupposition could be triggered and then neutralized, plausibly in the course of the semantic derivation. Or, the presupposition could not be triggered at all.

For a presupposition to not be triggered could mean one of two things. Some authors take some presuppositions to be privileged entailments of a sentence. Stalnaker (1973/1999), for example, writes:

> It is clear that "x knows that P" entails that P. It is also clear that in most cases when anyone asserts or denies that P, he (sic) presupposes that P.

Because "x knows P" also entails that x believes P, Stalnaker argues that the speaker's main point in uttering "x knows P" would be unclear unless the entailment that P were backgrounded, and

hence, presupposed. While his reasoning for this case has been challenged, e.g., by Abusch (2010), the practice of deriving presuppositions from entailments has become common (see, for example, Abrusán 2011 and references therein).[10] One sense in which a presupposition can go untriggered, then, is that the entailment that would give rise to it 'remains' an entailment. For the case at hand, if the factive presupposition of 'know' is not triggered in this sense, "x knows P" means "P and x has the belief P" and a sentence like "'x doesn't know that P" means "not P or x does not have the belief that P" (rather than the usual "P and x does not have the belief that P," if the presupposition that P had been triggered).

The second sense in which a presupposition can be said to not be triggered is simply that the inference that would have given rise to it is missing altogether from the meaning of a sentence. There is no presupposition, no entailment, or any other trace of that inference. Under this way of viewing non-triggering the factive inference, "x knows that P" without the inference that P simply means "x has the belief that P" and "x doesn't know that P" means "x does not have the belief that P."

When I talk, below, about the excluded middle presupposition not being triggered, I mean it in this second sense of magically absent from the meaning of 'believe.' There are two reasons for setting aside non-triggering in the first sense of not turning an entailment into a presupposition. One is simply that the excluded middle presupposition is not given to us as an entailment, whether it is directly encoded in the meaning of an attitude verb or whether it is introduced by a functional morpheme like $\mathrm{R_{EM}}$, in (34b). As noted by Mayr (2019, fn. 21) and Theiler et al. (2019, fn. 14), it is important for these accounts of anti-rogativity that the excluded middle inference be a semantic presupposition (compare with Romoli 2012, who derives the neg-raising inference as a scalar implicature). The second, related reason is that entailments that are candidates for being turned into presuppositions are distinguished, in one way or another, from the other entailments of a sentence (Abrusán, 2011). I will advance, without argument, that if we wrote the excluded middle down as an entailment conjoined with an assertion of belief, as in '(x believes p or x believes $\neg \mathrm{p})_{\mathrm{EM}}$ and x believes p,' there would not be any way of distinguishing one conjunct from the other, as this statement is equivalent to 'x believes p.'

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Now that we have said something about the two ways in which a presupposition can be said to

[10] Abusch points out that there are predicates like 'be right,' which entail truth and presuppose belief, thus constituting the mirror image of 'know' in terms of which of the two entailments is presupposed. The argument here is that the processus that turns entailments into presuppositions cannot be purely guided by conversational principles.

be untriggered, we turn to what it means for a presupposition to be neutralized after it has been triggered. I refer here to the process of local presupposition accommodation (Heim, 1988).[11]

This is a phenomenon where presupposed content behaves like it had been asserted in conjunction with regular asserted material. The phenomenon is typically motivated by examples like (37b). Here, if we drew the inference that there is a (unique) king of France, a presupposition triggered by the definite determiner, we would obtain a contradiction with the follow up given, which *denies* the existence of a king of France.

(37) a. The king of France is not bald.
$\rightsquigarrow$ There is a king of France.

b. The king of France is not bald. There is no king of France!
($\not\rightsquigarrow$ There is a king of France.)

While the example might sound contrived, there is at least a way of reading it that is not contradictory. A way of accounting for this is to take the presupposition in (37a) and to conjoin it, below negation, with the sentence's asserted content. No contradiction arises then. The contradictory and non-contradictory interpretations of (37b) are fleshed out in (38).

(38) a. **Projecting the presupposition past negation gives rise to a contradiction**:

(i) Contribution of 'The king of France is not bald':
There is an x s.t. x is king of France and x is not bald.

(ii) Contribution of 'There is no king of France':
There is no x s.t. x is king of France.

(iii) Conjoining (38a-i) and (38a-ii) implies a contradiction

b. **Conjoining the presupposition with the assertion under negation does not give rise to a contradiction**:

(i) Contribution of 'The king of France is not bald':
It is not the case that there is an x s.t. x is king of France and x is bald.

(ii) Contribution of 'There is no king of France':
There is no x s.t. x is king of France.

[11] There is also a phenomenon called *global (presupposition) accommodation* (Lewis 1979, although 'global' comes, I believe, from Heim 1988). In the case of (37), global accommodation derives the truth conditions "There is a king of France and he is not bald." Compare with (37b), where, under the local option, it is possible to deny the existence of a king of France. Globally accommodating the EM presupposition will not help to get rid of the neg-raising inference, as it would amount to asserting the EM presupposition in conjunction with the negated attitude report, effectively strengthening the latter. Notice also that the EM presupposition is a 'special' presupposition in that it need not be discourse old anyway (Gajewski, 2005; Collins, 2020).

(iii) Conjoining (38b-i) and (38b-ii) does not imply a contradiction (nor a tautology)

Let us consider a second illustration of local accommodation. Example (39) provides a sentence, from Beaver (2010), where the factive presupposition trigger 'discover' is inserted in the antecedent of a conditional. Three paraphrases are given, the third of which is not a possible meaning of the sentence.

(39) If the TA discovers that your work is plagiarized, I'll have to notify the dean.

a. **Projecting the factive presupposition out of the *if* clause**
≈ Your work is plagiarized. If the TA discovers it, I'll have to notify the dean.

b. **Accommodating the factive presupposition in the *if* clause**
≈ If your work is plagiarized and the TA discovers it, I'll have to notify the dean.

c. **Removing the factive inference entirely** (distinct from (39b) and unavailable)
If the TA comes to believe that your work is plagiarized, I'll have to notify the dean.

The paraphrase in (39a) corresponds to the option of projecting the factive presupposition past the antecedent of the conditional and (39b), to the option of accommodating it inside the antecedent. We may further imagine a hypothetical scenario in which 'discover' is stripped of the factive inference altogether to mean 'come to believe.' That is, 'x discovers p' is defined as presupposing p and entailing that x comes to believe p, and the presupposition is taken away. The paraphrase in (39c) attempts to bring out this possibility, but the attempt is unsuccessful.[12]

These examples show that, in the general case, locally accommodating a presupposition and removing it altogether from the meaning of a sentence give rise to detectable differences in meaning. These differences arise from the fact that a presupposition that is triggered and locally accommodated is taken into account in the derivation of the meaning of a sentence, even though its contribution might not be salient in the sentence's global truth conditions.

A caveat is in order before moving to the excluded middle presupposition. Local accommodation is easy to distinguish from non-triggering in the sense just discussed, but harder to distinguish from non-triggering in the sense of not turning an entailment into a presupposition. For example, the paraphrase in (39b) could be analyzed in two ways: Either 'x discovers p' triggers the presupposition that p and this is accommodated under 'if,' *or* 'x discovers p' entails p and this is left as an entailment.

[12]Another clear illustration of local accommodation involves factives under 'want.' An example like 'Dani wants to know that Joe and Kamala won' arguably only has a paraphrase where Dani's desire is for Joe and Kamala to have won and for her to be aware of that. The factive presupposition does not project past 'want' (see Uegaki 2015 against the background of Heim 1992 and von Fintel 1999), nor does it disappear entierly. The sentence cannot mean that Dani wants to form the (true or false) belief that Joe and Kamala won.

More specifically, non-triggering in this second sense is equivalent to local accommodation under a deepest operator and, in sentences with multiple operators, accommodation at intermediate levels, i.e., between two operators, is in principle possible (Beaver and Zeevat, 2007). Vincent Homer further draws my attention to the possibility of differentiating between non-triggering in this sense and local accommodation (Homer, 2011, pp. 177–178). I do not know, at this stage, how to turn his diagnostic lens to the excluded middle presupposition or whether this is at all possible. Homer relies on disrupting NPI licensing by triggering presuppositions but, the very presupposition that we wish to detect is one that licenses them.

3.2.2 Neutralizing the Excluded Middle presupposition and expectations about anti-rogativity

Let us now return to cases where the neg-raising inference is not drawn. Because we are assuming that the inference arises because of the excluded middle presupposition, the excluded middle presupposition must somehow be neutralized in the cases where it is not drawn. We are now in a position to talk about how.

The example in (40) provides the expected truth conditions of a negated thought report when the excluded middle presupposition is not triggered, in (40b), and when it is triggered and then locally accommodated under negation, in (40c). The observation is that these truth conditions are equivalent.

(40) a. Kim doesn't think that Brutus murdered Caesar.

b. **Truth conditions associated with not triggering the EM presupposition**

$\neg\text{believe}(\text{k}, \text{p})$

c. **Truth conditions associated with triggering and locally accommodating the EM presupposition under negation**

$\neg[[\text{believe}(\text{k}, \text{p}) \vee \text{believe}(\text{k}, \neg\text{p})] \wedge \text{believe}(\text{k}, \text{p})]$

$\neg\text{believe}(\text{k}, \text{p})$ $\qquad [(\phi \vee \psi) \wedge \phi \equiv \phi]$

As desired, however, these truth conditions are compatible with a situation where the attitude holder is not opinionated with respect to the truth of the embedded proposition—as they just state that it is not the case that Kim believes p, and this leaves open the possibility that she might not believe not p either. That is, they both derive the fact that the neg-raising inference is not drawn.

In sum, the neg-raising inference may be suspended either because the excluded middle pre-

supposition is not triggered, or because it is triggered and then locally accommodated. These two options are stated in (41).

(41) The neg-raising inference is not always observed because...

a. **Non-triggering**

The excluded middle presupposition is not triggered.

b. **Triggering + accommodation**

The excluded middle presupposition is triggered but can be locally accommodated under negation.

Determining how the excluded middle presupposition gets neutralized is a delicate issue, and I do not know how to tackle it head on. The difficulty is in part caused by the fact that the excluded middle presupposition does not behave like the others, in particular in its projective behavior. This is already noted by Gajewski (2005, section 2.3.1), who argues that the presupposition is 'soft' in the sense of Abusch (2010), and investigated in greater detail by Collins (2020).

To catch a glimpse of the difficulty here, taking Collins' empirical discussion at face value makes it seem like the excluded middle presupposition *must* project through negation—which would make the option given in (41b) unavailable—whereas it may be accommodated under the other familiar entailment canceling operators, i.e., antecedents of conditionals, questions, and possibility modals. On the flip side, it is unclear whether projection is available at all from within the latter.

With this in mind, we turn to what we expect happens when verbs like 'believe' and 'think' combine with embedded questions in cases where the excluded middle presupposition is neutralized, one way or the other. My goal is not to cast a doubt on explanations of anti-rogativity in terms of the excluded middle presupposition based on the observation that it is a strange presupposition. Rather, we will see that problems arise even if we assume that the excluded middle presupposition is well behaved.

The main finding that is reported in the literature is that 'believe wh-' does not become acceptable when the neg-raising inference is made unavailable in contexts of unopinionatedness (like Bartsch's). Witness example (42), repeated from Theiler et al.'s ex. (35).

(42) a. Bill doesn't know who killed Caesar. He isn't even sure whether or not Brutus and Caesar lived at the same time. So, naturally...

b. *Bill doesn't believe whether Brutus killed Caesar.

In the system sketched out by Theiler et al., there are no (syntactic or semantic) selectional restrictions on the predicate 'believe' that would prevent it from composing with questions. Neutralizing the neg-raising inference by not triggering the excluded middle presupposition then leads us to expect that such sentences should be acceptable and have the meaning paraphrased in (43), contrary to observation.

(43) Bill neither believes that Brutus killed Caesar nor that Brutus didn't kill Caesar.

The reason that we are looking at negated belief reports in unopinionatedness contexts is that these are cases where we are confident that the neg-raising inference is not drawn. But in fact, if the non-triggering option were available, we might even expect the positive counterpart of (42b) to be acceptable as well. The reasoning here is that if not triggering the excluded middle presupposition were an option, we might expect it to kick in and save structures where positive 'believe' and 'think' are composed with a question.

In contrast to non-triggering, if we assume that the excluded middle preuspposition *is* triggered and then locally accommodated in the cases where we do not detect it, it is possible to get a handle on the unacceptability of examples like (42b). Recall that Gajewski's linking hypothesis between L-analycity and ungrammaticality, repeated in (44) from (25), states that it suffices for there to be an L-analytical constituent in a sentence for that sentence to be ungrammatical.

(44) A sentence is ungrammatical if its logical form contains an L-analytic constituent.

The node labeled 2 below is that L-analytic constituent.

(45) $[_1$ NEG ... $[_2$ Bill [believe-R_{EM} [whether Brutus killed Caesar

This then brings us to the second thesis (T2) that emerges from Theiler et al. and Mayr's work. I believe the extension to the latter is fair, although Mayr does not explicity discuss cases where neg-raising is suspended.

(46) **Thesis T2**

Even when the neg-raising inference is not observed, the excluded middle presupposition is still triggered (and accommodated when needed).

There is also an architectural reason that commits these authors to the view expressed in (46), which

is that the morpheme $\mathrm{R_{EM}}$, responsible for introducing the excluded middle presupposition, is an integral part of the verbs that are pronounced 'think' or 'believe.'

The way that local accommodation should be implemented is not discussed by the authors cited, but it might be possible here to make use of Beaver and Krahmer's (2001) A operator (which they attribute to Bochvar 1939). The structure of neg-raising and non-neg-raising belief reports would then look as in (47):

(47) a. Neg-raising: EM triggered, not accommodated
[$_1$ NEG ... [$_2$ Bill [believe-$\mathrm{R_{EM}}$ [that Brutus killed Caesar

b. Non-neg-raising: EM triggered, accommodated under negation
[$_1$ NEG ... [$_{2'}$ A [$_2$ Bill [believe-$\mathrm{R_{EM}}$ [that Brutus killed Caesar

The semantics of the A operator is defined within a trivalent logical system as mapping true to true, false to false, and a third truth value ('N') corresponding to presupposition failure to false.

(48) The semantics of the A operator

ϕ	$\mathrm{A}(\phi)$
T	T
F	F
N	F

The idea here is that if the node labeled 2, in (47b), evaluates to N because the excluded middle presupposition is not satisfied, the A operator will map that to F, and negation will map F to T.

This operator can be inserted in the embedded question case as well, but this is only possible *after* 'believe' combines with its arguments and a constituent with an L-analytic meaning has been derived—as in (49).

(49) [$_1$ NEG ... [$_{2'}$ A [$_2$ Bill [believe-$\mathrm{R_{EM}}$ [whether Brutus killed Caesar

Thus, while locally accommodating the excluded middle presupposition might be possible, in (49), this will not render question embedding possible.

I will not say more about the A operator here, as I cannot tell whether the overall architecture of Theiler et al. and Mayr's systems and the appeal to Gajewski's notion of L-analycity port over transparently to a trivalent system. (See also Collins (2020) for a reason not to use the A operator, namely that it might have the undesirable effect of neutralizing every presupposition in its scope, not

just the excluded middle.) It is worth asking, however, what it would take to avoid ungrammaticality through L-analycity assuming that the excluded middle presupposition is triggered. Informative here is Roberts's (2019) discussion of sentences like (50):

(50) Susan can't believe which town was obliterated by the meteor.

Roberts explores the possibility of inserting material on top of 'believe wh-' to obviate the structure's triviality in meaning while at the same time relaxing Gajewski's linking hypothesis by delaying the point at which sentences are scanned for L-analytical constituents.

There is, however, a more pressing question. The two theories that we have been discussing are set up in such a way that 'think' should really not be compatible with embedded questions. Yet, we have been seeing that it is, as in (51).

(51) Anna is thinking whether she should invite Brian to the party.

Given what we have seen in this section, we set out to understand how to make sense of question embedding 'think,' and we begin by asking whether the possibility of embedding questions under 'think' presents a counter-example to Zuber's generalization or Theiler et al. and Mayr's Thesis T1. Thus we ask, is question embedding 'think' neg-raising?

3.3 Discussion

3.3.1 Is 'think' neg-raising in the environments in which it embeds questions?

While this question makes intuitive sense, it seems like any answer to it must be indirect because the neg-raising inference is only directly observed in declarative embedding. We will take a similar, indirect approach.

First, we must address a recent *positive* answer to this question found in White (accepted). White's main claim, which rests on large scale acceptability and inference judgment experiments as well as (more manageable) corpus evidence, is that the generalizations currently advanced to predict the distribution of embedded questions are false. Zuber's generalization ("a predicate is anti-rogative if it is neg-raising") is targeted, in particular, with the following argument.

First, similarly to what we have been seeing, White observes that 'think' may embed questions. Example (52) is one of his, retrieved from an online corpus.[13]

[13]Consistent with our observations that modals ameliorate question embedding under 'think,' example (52) contains a

(52) I was thinking whether there was a way to [. . .] help more than one person.

Second, if the example is modified in the most minimal way that would allow us to observe the neg-raising inference, the inference is observed. In (53), the embedded question has been replaced with a declarative, the matrix verb has been negated, and a strict NPI has been inserted in the embedded clause. The sentence is acceptable (judged with the NPI attached low), so the neg-raising inference is drawn.

(53) I wasn't thinking there was a way to help more than one person (at a time) until Jo got back from lunch.

The reason for engaging in this exercise is that there are ways, as we have seen, of suspending the neg-raising inference. A proponent of Zuber's generalization could then say, weakening any possible commitment to Thesis T2 in (46), that question embedding is possible in (52) because the neg-raising inference is not operative there. That the inference *is* drawn in minimally different (53) guards against this way out.

I supplement White's pair with a couple of my own, which make the same point. Question embedding is possible in the a. examples in (54), and the neg-raising inference is drawn in the b. examples, modified from their counterparts in the same way as above.

(54) a. (i) She was thinking whether I would arrive at midnight.
(ii) She wasn't thinking that I would arrive until midnight.
b. (i) The coach is thinking whether the playoff dreams are over.
(ii) The coach isn't thinking that the playoff dreams are over until they lose another game.

It then seems like 'think' embeds questions in linguistic environments that are very similar to the ones in which it gives rise to the neg-raising inference. This is evidence against Zuber's generalization, which leads us to expect that this should not be possible.

I would like to suggest, however, that there is a meaning difference between (52) and (53), as well as the members of the pairs in (54), which preclude us from using them as direct evidence against the neg-raising generalization. This difference is that the sentences with 'think whether' are built off of dynamic eventuality descriptions, whereas the sentences with 'think that' are built off of

modal expression "there is a way to X" (roughly, a possibility modal). Thanks to Vincent Homer for catching this.

stative descriptions (despite the progressive, see section 2.2.4). We now turn to why this difference in lexical aspect should matter when it comes to drawing conclusions about the relationship between neg-raising and question embedding.

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In work by Xiang (2013) and Bervoets (2014, 2020), we find a generalization that links the availability of the neg-raising inference to stativity. Bervoets writes, and I quote:

> All Neg-raisers are stative, and in the rare case where an eventive counterpart of a Neg-raiser is available, this eventive counterpart does not lead to extra-strong [i.e., neg-raised] readings with negation.[14] (Bervoets 2014:p. 112)

If this is so, we may not hope to find direct evidence against Zuber's generalization by looking at 'think.' Indeed, we have established that the result of composing 'think' with an embedded question is an eventuality description that is necessarily dynamic. If the neg-raising inference is only available for stative descriptions, 'think' cannot give rise to the inference when it embeds questions as it cannot give rise to stative descriptions when it does.

We now turn to what motivates this generalization. Xiang's evidence comes from the sensitivity to lexical aspect of two negative morphemes in Mandarin. I focus on Bervoets' examples, which directly involve 'think.' In (55), my understanding is that the 'when' and 'as' modifiers ensure that the sentences are eventive. In (55a), the strict NPI in the embedded clause is unlicensed, and from (55b), we do not intuitively draw the conclusion that the farmer is entertaining a negative thought. Both observations suggest that eventive 'think' is not neg-raising.[15]

(55) Eventive think (Bervoets 2014:ex. 186)

a. *The farmer wasn't thinking the tree fell until late last night when the barking dog startled him out of his reverie this morning.

b. As they turned the corner, the farmer wasn't thinking rain would help the situation.
   $\not\rightsquigarrow$ As they turned the corner, the farmer was thinking that rain wouldn't help the situation.

[14] Potential counter-examples to this generalization involve French *vouloir* in the passé composé and Ancient Greek οὔ φημι, 'I don't say' or 'I deny.' Thanks to Vincent Homer and Anna Giskes. Many thanks, also, to Travis Major, Connor Mayer and Colin Brown for help with judgments in this section.

[15] Strictly speaking, the NPI in (55a) could be unlicensed for reasons other than the absence of neg-raising and (55b) could involve local accommodation.

Bervoets' stative controls to (55) are provided in (56).

(56) Stative think (Bervoets 2014:ex. 185)

a. The farmer didn't think the tree fell until late last night.

b. The farmer didn't think rain would help the situation.
   ⇝ The farmer thought that rain wouldn't help the situation.

Bervoets shows that predicates other than 'think' pattern as expected with respect to the generalization that only statives are neg-raising. I provide additional support of my own based on the behavior of two other predicates, 'imagine' and 'guess,' which are among the neg-raising predicates listed by Collins and Postal (2014). The examples in (57) suggest that these predicates do license the neg-raising inference, at least for some speakers, in the present simple.

(57) a. I don't imagine that dragons will invade Wisconsin.
   ⇝ I imagine that dragons won't invade Wisconsin.

b. I don't guess that dragons will invade Wisconsin.
   ⇝ I guess that dragons won't invade Wisconsin.

The predicates also have an eventive use, which is not neg-raising. To see this, observe that the sentences with negated 'guess' and 'imagine,' in (58), have a reading where they do not imply their counterparts with negation in the embedded clause. This obtains when one reads 'imagine' as 'form a mental image of' and 'guess' as a speech act—as opposed to reading them as expressing opinion as in (57).

(58) a. I'm not imagining that dragons will invade Wisconsin.
   ⇏ I'm imagining that dragons will not invade Wisconsin.

b. I'm not guessing that dragons will invade Wisconsin.
   ⇏ I'm guessing that dragons will not invade Wisconsin.

The reader is invited to check that much like 'think,' in frames where these predicates are stative (and neg-raising), they do not embed questions, but when they are dynamic (and not neg-raising), they are able to.

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White and Bervoets both present examples with 'think' in the progressive. In White's set, the

neg-raising inference is available, whereas in Bervoets' set, it is not. What we can conclude from this discussion is that *progressive* 'think' alternates in its compatibility with the inference. In describing the aspectual profile of 'think that' in section 2.2.4, we have not only seen that the predicate could occur under either a stative or a dynamic guise but also that progressive 'think that' occurred under both guises. If this is on the right track, it does not suffice to look at whether progressive 'think' is neg-raising or not to draw conclusions about whether question embedding 'think' is neg-raising or not. We either need to include an additional test on top the progressive (which Bervoets does) that would disambiguate in favor of *think*'s stative vs. dynamic understanding, or we need to look at other environments where *think*'s ambivalence is less of a confound.

Let us now see whether we can gather additional evidence in favor of an alternation in the availability of neg-raising with 'think' conditioned by stativity and, relatedly, the view that question embedding 'think' is not neg-raising.

The progressive

In data attested online, we find that negated progressive 'think' is used both to attribute negated thoughts and to signal the absence of a thinking activity.

The intuition behind example (59) and what the author intended it to mean is clear. The coach is directly quoted and the quote commits him to the belief that the playoff dreams are not over. A reporter expresses this state of affairs with a negated progressive 'think.'[16]

(59) —Coach Pete DeBoer says he's not thinking that the playoff dreams are over.
"I don't feel that way [. . .]"

In contrast with (59), negated progressive 'think' in (60) does not ascribe to the attitude holder a negative belief. Here, the author expresses the absence of a thought.[17]

(60) The cigarette needs to be gotten rid of, where no one can see, and he's not thinking that the smoke will linger on his clothes or his fingers as evidence [. . .]

These examples can be modified to include strict NPIs in the complement, shown below. In the first case, the NPIs are licensed and in the second, they are not.

[16]Kyle Rawlins (p.c.) observes that the inference that the coach has a negative belief might be arising due to world knowledge: Coaches usually have an opinion about whether their team will make the playoffs. This is true, but as we see in the examples in (61), this report patterns like other bona fide neg-raising reports in that strict NPIs are licensed in the embedded clause by matrix negation.

[17]I also read this sentence as factive, in the sense that the author is committed to the belief that the smoke will linger on the attitude holder's fingers.

The examples in (61) are modifications on (59). For subexample a., the strict NPI needs to be judged with low attachment, giving rise to a meaning synonymous with "the coach thinks that the playoff dreams are not over until they lose another game" and not to a futurate understanding of the matrix verb along the lines of "he's not thinking that until they lose another game." For subexample b., where low attachment of the strict NPI "in years" is the only option, it helps to imagine a context where the playoff dreams alternate between going on and being over, but that they have *not* been over in several games.[18]

(61) a. Coach Pete DeBoer says he's not thinking that the playoff dreams are over until they lose another game.

b. Coach Pete DeBoer says he's not thinking that the playoff dreams have been over in several games.

The examples in (62) are modifications on (60). Here, the strict NPI in the complement is not licensed by negation on progressive 'think.' The observation that the strict NPI is licensed by embedded negation, in (62b), suggests that the unacceptability of (62a) is due to the failure of licensing the NPI across a clause boundary. This, in turn, suggests that such examples are not neg-raising.

(62) As he's getting rid of the cigarette,

a. *he's not thinking that the smoke has lingered on his clothes in years. (So why would it this time?)

b. he's thinking that the smoke hasn't lingered on his clothes in years. (So why would it this time?)

Progressive 'think' does indeed seem to come in two guises, one neg-raising and the other not. The former introduces a stative belief ascription, the latter corresponds to an activity.

Evidence from the simple tenses

If 'think' alternates in being stative and neg-raising, and dynamic and non-neg-raising in the progressive tenses, we expect to be able to detect this alternation in other tense/aspect combinations as well, and in particular, in the simple tenses.

The present simple is a good test case, because it creates an environment in which stative and

[18]This is another test that might serve to disambiguate sentences in favor of neg-raised readings: *Anna doesn't think/?isn't thinking that her scoby's healthy. She's gonna do something about that.*

dynamic uses of event descriptions can clearly be teased apart. In (63), we have a neg-raising 'think' report in the present simple.

(63) Anna doesn't think that the Raptors can win (until they get better players).

We can force this report to be dynamic by giving the present simple its sportscaster's present use. This is illustrated in (64a). As shown in (64b), strict NPIs are unlicensed here—suggesting that making the report dynamic removes the availability of neg-raising. The control sentence in (64c) suggests that strict NPIs may be licensed by embedded negation in this frame.[19]

(64) a. Anna looks at the scoreboard, doesn't think that the Raptors can win, walks out.
b. *Anna looks at the scoreboard, doesn't think that the Raptors can win until they get better players, walks out.
c. Anna looks at the scoreboard, thinks that the Raptors can't win until they get better players, walks out.

A similar paradigm replicates with 'think' in the simple past. Example (65) shows that neg-raising is possible in principle:

(65) Anna didn't think that the Raptors could win (until they got better players).

The sentences in (66) suggest, however, that when we force simple past 'think' to introducing a dynamic description, the neg-raising inference is lost. Here, I again use advancement of narrative time to disambiguate in favor of dynamic interpretations.[20]

(66) a. Anna looked at the scoreboard, didn't think that the Raptors could win, walked out.
b. *Anna looked at the scoreboard, didn't think that the Raptors could win until they got better players, walked out.
c. Anna looked at the scoreboard, thought that the Raptors couldn't win until they got better players, walked out.

Question embedding 'think' occurs in the present simple, restricted to the special interpretations that the present simple gives rise to with eventive descriptions. It also occurs in the past simple,

[19]The example in (64a) does convey that the attitude holder thinks that the Raptors can't win. This inference must have a different source from the neg-raising inference given that strict NPIs go unlicensed.

[20]One may wonder, again, whether the inchoative of stative thought reports pattern differently, in this frame, from thought reports that are bona fide activities.

more naturally, but also with the same interpretive signature as other eventive descriptions. This is illustrated in (67).

(67) a. Anna looks at the scoreboard, thinks whether the Raptors could win, walks out.

b. Anna looked at the scoreboard, thought whether the Raptors could win, walked out.

If question embedding 'think' were generally compatible with neg-raising, we expect to observe the inference in environments other than the progressive where 'think' is able to embed questions, like the ones in (67). What we have seen in the series of examples in (64) and (66), however, is that neg-raising is made unavailable in these environments—strongly suggesting that 'think' cannot be neg-raising in the environments in which it is able to embed questions, and that the absence of the inference is linked to the obligatory dynamicity of 'think + Q.'

3.3.2 Undesirable consequences of maintaining neg-raising based accounts

We have established that 'think' may embed questions, and that when it embeds questions, it is both dynamic and not neg-raising. Let us spell out the consequences of these findings for proposals that account for the '*believe wh-' puzzle in terms of the excluded middle presupposition being the cause of anti-rogativity. The two central theses of such proposals are repeated in (68) for ease of reference:

(68) a. **Thesis T1**

semantic excluded middle presupposition → anti-rogativity

"For any sentence embedding predicate P, if P is associated with the excluded middle, P does not embed questions."

b. **Thesis T2**

Even when the neg-raising inference is not observed, the excluded middle presupposition is still triggered (and accommodated when needed).

As discussed in the previous section, White (accepted) presents data that suggests that T1 might be false—namely, potential instances of question embedding and neg-raising 'think.' However, as we have seen, a closer look at his data revealed that we could not take it as evidence against T1. In environments where 'think' embeds questions, the neg-raising inference is *un*available. As a result, we seem to lack direct evidence against T1.

Authors like Mayr and Theiler et al. need to commit to Thesis T2 in addition to Thesis T1 to account for the observation that question embedding under 'think' does not become possible even

in contexts where the neg-raising inference is contextually suspended. This is illustrated in (69).

(69) (Anna has no knowledge of Roman history so. . .)

a. she doesn't think that Brutus killed Caesar.

b. *she doesn't think whether Brutus killed Caesar.

However, as we have seen, the neg-raising inference may also be suspended in examples like (70a), which involve 'think' in the progressive. In the same environment question embedding *is* possible.

(70) a. Anna isn't thinking that she should invite Brian.

b. (i) Anna is thinking whether she should invite Brian.

(ii) Anna isn't thinking whether she should invite Brian.

Thesis T2, as it currently stands, leads us to expect that question embedding should be impossible in (70) as well. That is, we do not have the means to predict a difference between cases like (69) and cases like (70).

Note that there is a sense in which examples like (70) support Thesis T1. Indeed, we are working with theories where embedded questions are selected freely, but ungrammatical in the presence of neg-raising. Ordinarily, these theories would say, neg-raising is active and we do not observe question embedding with 'think,' but when neg-raising is independently unavailable, question embedding becomes acceptable—as expected.[21]

To account for the difference in behavior illustrated by (69) and (70), we could weaken Thesis T2 into the following, disjunctive statement.

(71) Thesis T2′

When the neg-raising inference is not observed, this could be because

a. the excluded middle presupposition has been triggered, but accommodated, or

b. the excluded middle presupposition has not been triggered.

In addition to this modification to Thesis T2, we further need to say that cases like (69) involve triggering and locally accommodating the excluded middle presupposition, and that cases like (70)

[21] Mayr (2019) discusses a restriction on the distribution of embedded clauses that is independent of the excluded middle presupposition. Predicates like 'be certain,' which are non-veridical and non-neg-raising, are polarity sensitive. They are most natural with questions only when negated: *Anna is ?(not) certain whether she should invite Brian*. As indicated by the (lack of evidence for the) absence of a contrast between positive (70b-i) and negated (70b-ii), 'think + Q' differs from 'be certain' and does not seem to be polarity sensitive. See also Uegaki and Sudo (2019) about why non-veridical preferential predicates like 'hope' might be anti-rogative.

involve no triggering. According to T2′ coupled with T1, the former are now expected to be unacceptable, and the latter, acceptable.

Theiler et al. (2019) are already implicitly committed to the weaker Thesis T2′. They acknowledge, in their footnote 11, that *believe* embeds questions under certain circumstances (see also Roberts 2019). They give the examples in (72).

(72) a. You won't believe who won.
b. He just wouldn't believe me who I was.

The authors further note that in these frames in which 'believe' embeds questions, the neg-raising inference is not available (a point reinforced by White 2020). To wit, the embedded strict NPIs in (73) are not licensed by matrix negation (they are by embedded negation):

(73) a. (i) You won't believe that Mary has won (*in ages).
(ii) You won't believe that Mary hasn't won in ages.
b. (i) He just wouldn't believe me that Mary had won (*in ages).
(ii) He just wouldn't believe me that Mary hadn't won in ages.

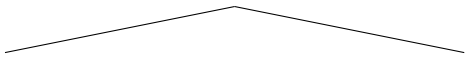
There may be additional complicating factors here, the discussion of which would take us off topic (see, for example, Staniszewski 2017 for the unavailability of neg-raising in general under 'will'). But if it is assumed that Thesis T1 accounts for the anti-rogativity of 'believe,' in general, Thesis T2 cannot hold unconditionally. There must be cases where the neg-raising inference is not observed *and* where the excluded middle presupposition has not been triggered.

Now we will have to understand how T2′ can be implemented, and how it can be restricted. Indeed, if the option of not triggering the excluded middle presupposition were always available, the unacceptability of (69) with an embedded question is unexpected.

Given the architectural assumptions that we have to make in order to maintain T1, it is not straightforward to implement T2′. The reason is that for T1 to deliver ungrammaticality with embedded questions, we assume that the excluded middle presupposition is encoded in the semantics of a head, call it R_{EM}, which composes with a modal base to output an attitude verb.

(74) ‘think$_{+\mathrm{NR}}$’ : (st)et

$\lambda p.\lambda x.\lambda w : dox(x, w) \subseteq p \vee dox(x, w) \subseteq \neg p.dox(x, w) \subseteq p$



$\mathrm{base}_{\mathrm{dox}}$ $\quad$ R_{EM}

$\lambda x.\lambda w.dox(x, w)$ $\quad$ $\lambda \mathrm{B}_{\mathrm{est}}.\lambda p.\lambda x.\lambda w : \mathrm{B}(x, w) \subseteq p \vee \mathrm{B}(x, w) \subseteq \neg p.\mathrm{B}(x, w) \subseteq p$

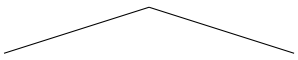
To account for the observation that there exist occurrences of ‘think’ that are not neg-raising and that do not come with the excluded middle presupposition, we have to say one of two things.

We could say that English has a predicate pronounced ‘think’ that is built up of the pieces provided in (74), alongside another predicate pronounced ‘think’ that has the semantics of an attitude verb that does not trigger the excluded middle presupposition. This option is undesirable. Without additional stipulations, it does not give us a handle on the interaction of lexical aspect, question embedding, and neg-raising.[22]

Alternatively, we could posit the existence of a neutral $\mathrm{R}_{\mathrm{neut}}$ whose task it would be to compose with a doxastic modal base and output an attitude verb without introducing the EM presupposition.

(75) ‘think$_{-\mathrm{NR}}$’ : (st)et

$\lambda p.\lambda x.\lambda w.dox(x, w) \subseteq p$



$\mathrm{base}_{\mathrm{dox}}$ $\quad$ $\mathrm{R}_{\mathrm{neut}}$

$\lambda x.\lambda w.dox(x, w)$ $\quad$ $\lambda \mathrm{B}_{\mathrm{est}}.\lambda p.\lambda x.\lambda w.\mathrm{B}(x, w) \subseteq p$

To account for the difference between (69) and (70), we would then need to assume that the former involves a structure with R_{EM} and the latter, one with $\mathrm{R}_{\mathrm{neut}}$. These hypothetical structures are provided in (76):

(76) a. (i) *Anna doesn’t think whether Brutus killed Caesar.

(ii) NEG [Anna [[think R_{EM}] [whether Brutus killed Caesar]]] *

b. (i) Anna isn’t thinking whether she should invite Brian.

(ii) NEG [Anna [[think $\mathrm{R}_{\mathrm{neut}}$] [whether Brutus killed Caesar]]] ✓

[22]Deriving L-analytical truth conditions for ‘think + Q’ via the EM presupposition relies on the attitude verb’s assertion being a plain statement of belief. The present discussion assumes the same. In section 4, we will move towards a different denotation for ‘think.’ Indeed, as we have seen in 2, ‘think’ should denote more than just a belief operator that comes with or without the excluded middle presupposition, as suggested by the simplified presentation in (74) and (75).

There is nothing, in principle, that should prevent us from deriving neg-raising inferences via the insertion of functional heads, or from decomposing attitude verbs into smaller meaningful pieces.[23] For the account sketched out here to be fully explanatory, however, we need to find systematic ways of restricting the distribution of $\mathrm{R}_{\mathrm{neut}}$ and R_{EM}.

In particular, the head R_{EM} should not be licensed in structures with dynamic eventuality descriptions. This is because we do not observe dynamic predicates giving rise to the neg-raising inference. (Alternatively, here, we could say that R_{EM} is free to occur within dynamic eventuality descriptions, but that in such cases, the presupposition it contributes is obligatorily neutralized by local accommodation.) On the other hand, the head $\mathrm{R}_{\mathrm{neut}}$ should not be licensed in structures with stative eventuality descriptions. And this is because we never observe embedded questions with 'think,' when it constructs a stative eventuality description.[24]

3.3.3 Outlook

The upshot of this discussion is that we are not in a position to reject Thesis T1 directly, the thesis according to which a triggered excluded middle presupposition causes a predicate to be incompatible with embedded questions. However, we have observed that question embedding under 'think' is available in many sentence frames, and that there is a link between the availability of question embedding, dynamicity, and (non-)neg-raising. If we want to account for these descriptive facts while at the same time remaining committed to T1, we are forced to make a series of additional assumptions that move us away from being able to explain them.

In the next section, I would like to provide a semantics for 'think' that gives rise to an eventuality description that is necessarily dynamic when the verb's clausal argument is a question and to an eventuality description that has the option of being stative when that argument is a declarative.

This hypothesis about the meaning of 'think' will give us a handle on why the predicate does not occur with embedded questions in the present simple with an ongoing state or an ongoing event interpretation. These interpretations are paraphrased in (77b-i) and (77b-ii) below.

---

[23] A language where the hypothetical 'think$_{+\mathrm{NR}}$' and 'think$_{-\mathrm{NR}}$' are pronounced differently might provide evidence in favor of R_{EM} and $\mathrm{R}_{\mathrm{neut}}$.

[24] I do not derive the link between stativity and neg-raising. We could write down a morpheme similar to Theiler et al.'s R_{EM} that would be restricted to composing only with stative predicates. Allowing this morpheme to take attitude verbs as input (rather than modal bases) would side-step the duplication problem discussed around (75).

$[\![\mathrm{R}'_{\mathrm{EM}}]\!] = \lambda \mathrm{V}_{(\mathrm{st})\mathrm{evt}}.\lambda \mathrm{p}_{\mathrm{st}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}} : \mathrm{state(e)} \wedge [\mathrm{V(p,x,e)} \vee \mathrm{V}(\neg \mathrm{p,x,e})].\mathrm{V(p,x,e)}$

Vincent Homer (p.c.) remarks that generating the neg-raising inference in this way runs the risk of over-generating neg-raising reports. For instance R_{EM}(hope) should be possible, giving rise to a neg-raising 'hope,' which is not attested. (Danish 'hope' is cited by Horn (1978) as neg-raising, however: *Jeg håber ikke, at De blev bange*, "I hope that you're not feeling bad.") Other accounts of neg-raising also make use of some stipulation to rule out such cases. Ultimately, however, such accounts do not *explain* the link between neg-raising and lexical aspect.

(77) a. #Anna thinks whether she should invite Brian.

b. Does not mean:

(i) Anna has a thought about whether she should invite Brian.

(ii) Anna is thinking whether she should invite Brian.

The ongoing state interpretation will be unavailable because 'think + Q' will come out as a dynamic predicate, and the ongoing event interpretation will be unavailable because dynamic predicates do not give rise to ongoing event interpretations in the present simple.

We will also have a handle on why the restrictions on composing 'think' with questions are lifted in tense/aspect combinations other than the present simple. Such tense/aspect combinations are free to combine with dynamic predicates. Sentence (77b-ii) is possible, for example, because the progressive of an activity predicate is unproblematic.

In examples like (78), we were attempting to suspend the neg-raising inference and get 'think' to compose with embedded questions. This turns out to not be possible. Instead of attempting to explain such examples by appealing to mysterious (and, it seems, undetectable) operations involving triggering and accommodating presuppositions, I will simply say that the unacceptability of (78) has the same source as the unacceptability of (77a).

(78) Anna has no knolwedge of Roman history so... *she doesn't think whether Brutus killed Caesar.

Indeed, dynamic predicates are unacceptable in the present simple (with an ongoing event interpretation) regardless of whether the present simple verb is negated or not.

(79) a. (i) Anna likes snails.

(ii) Anna doesn't like snails.

b. (i) #Anna runs.

(ii) #Anna doesn't run.

This being the case, we will not need to appeal to T1 to explain the behavior of 'think' with embedded questions, and we will not need to appeal to T2 or to T2′ either.

According to T1, there is a direct link between the excluded middle presupposition and anti-rogativity, with the former causing the latter. In the picture that we are moving towards, neg-raising and anti-rogativity are not directly linked, but they are linked through lexical aspect. Here is what

I mean: When the eventuality description corresponding to an attitude like 'think' is stative, neg-raising is possible and question embedding is impossible. On the other hand, when that eventuality description is dynamic, question embedding is possible and neg-raising, impossible. This is by virtue of the two generalizations that we have identified:

(80) a. If 'think + Q' embeds a question, the eventuality description it introduces is dynamic.
b. If 'think' introduces a dynamic eventuality description, the attitude report it gives rise to cannot be neg-raising.

While it is true that neg-raising and the possibility of embedding questions are not properties that we may ever hope to observe together, it is misguided to think that the former precludes the latter. Rather, neg-raising and anti-rogativity have a common explaining factor: Stativity. In the following, we will move towards an understanding of the link between lexical aspect and question embedding. We will, however, have to leave the link between lexical aspect and neg-raising for further research.

I stress that I have neither made a direct nor a general case against explaining anti-rogativity in terms of the excluded middle presupposition. In a sense, one could still argue that 'think' is ambiguous between an anti-rogative and a responsive variant, that the explanation of anti-rogativity in terms of the excluded middle presupposition applies to the former. Or, one could argue that the explanation might apply to neg-raising predicates other than 'think,' like 'believe.' This is true.

Chapter 4

Think

In this section, I develop a hypothesis about the lexical semantics of 'think' that explains its attitude and eventuality related entailments. Namely, we will see how to derive a belief entailment when the complement of 'think' is a declarative, and entailments of agnosticism and curiosity, when the complement is a question. We will also see how to derive an eventuality description that is necessarily dynamic when the complement of 'think' is a question, and one that can be stative, when the complement is a declarative.

The definition at the core of the proposal is given in (1).

(1) $[\![\mathrm{think}]\!] = \lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

'Think' is modeled as a function that takes a set of propositions P, an individual x, and an eventuality e as arguments and that returns true iff two conditions are satisfied. First, the inquisitive state $\mathrm{INQ}(\mathrm{x},\mathrm{e})$ of x calculated at e must be a subset of P. Second, every proposition p in a distinguished subset $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ of P must be such that there is a subeventuality e' of e that is an eventuality of x evaluating p. The rest of this chapter is dedicated to motivating and elaborating on the components of this hypothesis.

Attitude-related entailments The proposal retains the traditional Hintikkan core of the semantics of belief ascriptions, given in (2), which states that x believes a declarative p at w iff all of the possible worlds compatible with x's beliefs at w ('DOX(x,w)') are worlds at which p is true.

(2) "x believes p" is true at w iff $\mathrm{DOX}(\mathrm{x},\mathrm{w}) \subseteq \mathrm{p}$

This stems from the fact that when P, from (1), is a declarative denotation, requiring an individual's inquisitive state to be a subset of P is equivalent to saying that all of their belief worlds are ones at which the declarative is true (Ciardelli and Roelofsen 2015, a.o.). Using inquisitive states in (1) allows us to talk about question directed 'think' reports, which a semantics based on doxastic states alone does not straightforwardly suffice for. My extension to the question cases incorporates proposals on question directed attitudes introduced by predicates like 'wonder,' 'think about,' and an Estonian predicate 'mõtlema,' which is similar to English 'think' in many respects (Ciardelli and Roelofsen 2015, Ciardelli et al. 2018, Theiler et al. 2019, Rawlins 2013, Roberts 2018, Roelofsen and Uegaki 2020, a.o.).

Event-related entailments Both of the conjuncts in (1) specify the internal structure of a thinking eventuality e and the second conjunct in particular makes that structure depend on the embedded clause denotation P. 'Think' is designed to be able to compose with declaratives and with questions alike. But declarative denotations and question denotations differ, despite possibly being of the same type. This induces a difference in the internal structure of e, which can then be linked to a difference in lexical aspect conditioned by clause type.

4.1 Background

4.1.1 Propositions and sets thereof

In this section, I lay out my assumptions about what embedded declaratives and questions denote. An informed reader may skip this section: I assume, following work in inquisitive semantics, that embedded clauses denote downward closed sets of propositions, of type (st)t, and that declarative denotations differ from question denotations in that the former have a single maximal element, and the latter, many (Ciardelli et al., 2018, a.o.).

A traditional picture

Declaratives are traditionally modeled as denoting propositions, that is, sets of possible worlds or characteristic functions thereof, of type st. Members of this set are all and only the possible worlds where the proposition is true. A standard way of modeling questions is to let them denote sets of propositions, or characteristic functions of such sets, of type (st)t. The propositions in a question denotation correspond to the semantic answers to the question. This state of affairs is illustrated

in (3), which does not do justice to a rich array of refinements and alternatives. I use W for the domain of possible worlds and an arbitrary subset of W for the denotation of the declarative. The polar question denotation given in (3c) is a set consisting of the set denoted by "that it's raining" and of the set denoted by "that it's not raining," which are complements of each other. The subscript 'vanilla' on the denotation brackets is meant to signal that we are talking about usual denotations for declaratives and questions, as opposed to their denotations in inquisitive semantics.[1]

(3) a. $\mathrm{W} = \{\mathrm{w}_1, \mathrm{w}_2, \mathrm{w}_3, \mathrm{w}_4\}$

b. $[\![\text{that it's raining}]\!]_{\text{vanilla}} = \{\mathrm{w}_1, \mathrm{w}_2\}$

c. $[\![\text{whether it's raining}]\!]_{\text{vanilla}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_3, \mathrm{w}_4\}\}$
$= \{[\![\text{that it's raining}]\!]_{\text{vanilla}}, [\![\text{that it's not raining}]\!]_{\text{vanilla}}\}$

***

The assumption that declarative and question denotations have different types leads to analyses of clausal embedding that are not fully satisfactory—as also discussed in section 3.1.1. At least at first sight, attitude verbs differ in whether they are able to occur with declaratives or questions, a simplified picture being that 'believe' only occurs with declaratives, 'wonder,' only with questions, and 'know' with both. We then have to square the denotations of these attitude verbs with the type difference illustrated in (3), perhaps by saying that 'believe' only selects for objects of type st and 'wonder,' of type (st)t. The existence of predicates like 'know' complicates things, as we either have to say that the predicate is ambiguous between a declarative selecting variant and a question selecting variant, or that there are ways of turning question denotations into declarative denotations (or the other way around).

The first issue is, however, that saying something like "*believe* selects for objects of type st" makes it look like it is an idiosyncratic property of this verb to select for declaratives, that this fact does not follow from anything else. This is a possibility, but we observe regularities that govern whether a given verb will be compatible with declaratives, questions, or both. For example, all anti-rogatives seem to be neg-raising, all responsives seem to be veridical, and so on (Zuber, 1982; Mayr, 2019; Theiler et al., 2019; Egré, 2008; Roelofsen and Uegaki, 2020, a.o.). If the 'selectional' properties of attitude verbs are linked to their independently observed semantic properties, we do not want to

[1] I provide a bipolar representation of polar questions, where both the positive and the negative answer is included (Hamblin, 1973). There are monopolar analyses available, where polar question denotations consist of a single proposition. My understanding is that arguments for a monopolar analysis come from root polar questions and we are dealing with embedded questions throughout. (Thanks to María Biezma for discussion here.) Furthermore, I do not adopt Karttunen's (1977) hypothesis that only true propositions make it into question sets. Both of these points mean that we keep to a bipolar analysis.

treat the former as idiosyncratic—as this leaves the regularities observed unexplained.

The second issue is that certain verbs alternate in whether they are able to occur with embedded questions. 'Think,' as we have been seeing, does not easily occur with questions when it is in the present simple, but is freeer to do so in other tense aspect combinations (similar facts hold of 'believe,' 'be certain' and perhaps other verbs). Semantic selection is specified for functions and is a relation that is local to the function (the verb) and its argument. We do not expect expressions higher up the tree, so to speak, to affect it. That is, if we say that 'think' selects for declaratives, tense and aspect should not be able to relax this restriction and let 'think' select for questions. We could treat the predicate as ambiguous between a declarative selecting and a question selecting variant. But then, we would have to explain why the declarative selecting variant of 'think' occurs freely, while its question selecting variant is restricted in its distribution. (This is not an unreasonable way of stating the problem. There is, however, a way of explaining the behavior of 'think' with embedded questions that does not resort to ambiguity. And this is what we will opt for.)

Reducing from Q to P or from P to Q

As a consequence of these kinds of issues, the push in the literature has been to move towards uniform analyses of clausal embedding, which efface semantic type differences between declaratives and questions. There are two general strategies for doing so: One involves reducing question denotations to propositions ('Q to P'), and the other involves reducing declarative denotations to questions ('P to Q').

An overarching property of approaches based on Q to P reduction is that they provide ways of making questions denote one of their answers, that is, a proposition. I illustrate with two ways of achieving this result. Groenendijk and Stokhof (1984) propose, for example, that questions denote propositional concepts, of type sst. These are question intensions. (I subscript the denotation brackets in (4) with 'GS' to indicate that this is a Groenendijk and Stokhof inspired denotation and use ':=' for the definition, as an equals sign occurs in the body of the lambda expression.)

(4) $[\![\text{whether it's raining}]\!]_{\mathrm{GS}} := \lambda \mathrm{w}.\lambda \mathrm{w}'.[\![\text{that it's raining}]\!](\mathrm{w}') = [\![\text{that it's raining}]\!](\mathrm{w})$

In our toy model in (3), it is not raining at w_4. If we saturate the first world argument in (4) with w_4, and, briefly switching to function talk, what we get is the proposition that it's not raining.

(5) $[\![\text{whether it's raining}]\!]_{\mathrm{GS}}(\mathrm{w}_4) := \lambda \mathrm{w}'.[\![\text{that it's raining}]\!](\mathrm{w}') = [\![\text{that it's raining}]\!](\mathrm{w}_4)$

$$:= \lambda w'.[\![\text{that it's raining}]\!](w') = 0$$
$$:= [\![\text{that it's not raining}]\!]$$

In Groenendijk & Stokhof, then, the extension of a question at a given world *is* the (strongly exhaustive) true answer of that question at that world.

Working with Hamblin/Karttunen alternative set denotations for questions, authors like Heim (1994), Dayal (1996) and others propose instead to use answerhood operators to map alternative sets like (3c) to some answer to the question. This is often a weakly or strongly exhaustive *true* answer to the question, but Q to P need not involve reducing the question to a true proposition. (At least Lahiri (2002) and Spector and Egré (2015) provide ways of reducing questions to their possible answers, which are not necessarily their true answers.) Let us illustrate this way of reducing from Q to P for the question "whether it's raining" from (3c). In (6), assume that 'Ans' is an answerhood operator mapping a polar question and a world to the true answer to the question at that world.

(6) $[\![\text{Ans}]\!]([\![\text{whether it's raining}]\!]_{\text{vanilla}})(w_4) = \{w_3, w_4\} = [\![\text{that it's not raining}]\!]_{\text{vanilla}}$

Q to P reduction is one way of accounting for the observation that some attitude verbs that embed both declaratives and questions are such that, when they embed a question, they introduce an attitude towards a particular answer to that question. For example, in a context where we know that it's not raining, e.g., at world w_4, the sentences "Anna knows whether it's raining" and "Anna told Brian whether it's raining" entail that Anna knows or, respectively, told Brian that it's not raining. This follows from the fact that we interpret "whether it's raining" as the true answer to the question at w_4, namely, as "that it's not raining."

For verbs like 'wonder,' which do not embed declaratives, we will not want to reduce questions to propositions. An intuitive way of seeing this is that while it is possible to paraphrase (7a), with 'know whether' with appropriately coordinated 'know that' statements, no such paraphrase is available for (7b), with 'wonder whether.'

(7) a. Anna knows whether it's raining.
   $\rightarrow$ If it's raining, Anna knows that it's raining and if it's not raining, Anna knows that it's not raining.
   b. Anna wonders whether it's raining.

A related intuition is that (7b) describes an attitude towards the embedded question, and not to any

one of its answers.[2]

The main empirical observation here is that examples where 'think' embeds questions (and is deliberative) are similar to examples with 'wonder,' rather than to examples with 'know.' Indeed, example (8a) does not receive the paraphrase in (8b), or ones similar to it with 'think that.'[3]

(8) a. Anna is thinking whether she should invite Brian.

b. Anna is thinking that she should invite Brian or Anna is thinking that she shouldn't invite Brian. (not a paraphrase of (8a))

Just like with 'wonder,' in (8a), we have the intutition that Anna is doing something with the question, rather than with any one of its answers.

The analytical consequence here is that when 'think' combines with something that is syntactically a question, it composes in the semantics with a question denotation that has not been reduced to a proposition. That is, we will not opt for Q to P reduction. Now we face a brief difficulty: 'Think' also combines with declaratives, which our initial 'vanilla' model from above treats as denoting propositions. We want to avoid ambiguity, so we will need a way of turning propositions into question denotations and opt for P to Q reduction.[4] In the following, I will make use of inquisitive semantics, which is one particular framework that is based on P to Q reduction. That said, opting for P to Q does not require using inquisitive semantics (see, for example, Uegaki 2015) and using inquisitive semantics does not mean that the core contributions of this dissertation cannot be implemented within alternative approaches to question embedding, like Groenendijk & Stokhof's partition based semantics. (In fact, my analysis of 'think + Q' shares similarities with Rawlins (2013) analysis of 'think about,' who uses a partition based semantics.) Much recent work on question embedding (in particular, work on 'wonder') is couched in the inquisitive semantic framework, however, and I believe that using it here should allow for clearer comparisons between what is said here, and what is said elsewhere. (For independent arguments in favor of the superiority of P to Q to Q to P, I refer the reader to Elliott et al. (2017) and Roberts (2018).)

[2]Karttunen (1977) proposes, and sets aside, a paraphrase where 'wonder' is replaced with 'wish to know that,' and Uegaki (2015) makes use of a similar analysis to derive the anti-rogativity of 'wonder.' The reader will grant that there is still a difference between 'know'-like verbs and 'wonder'-like verbs, which is what we are interested in modeling.

[3]The fact that such a paraphrase is not available is not due to the progressive. 'Figure out' and 'remember' are predicates that may occur in the progressive with questions and with declaratives, while at the same time allowing for a Q to P inference: Anna was figuring out/remembering who the murderer was. The murderer was Francis. So Anna was figuring out/remembering that the murderer was Francis.

[4]Vincent Homer, p.c., raises concerns over letting 'think' combine freely with declaratives and with questions in light of the observation that 'think' is not always acceptable with any kind of embedded question: *Anna was thinking whether she should invite/?had invited Brian*. Rajesh Bhatt, p.c., points out that the example without the modal improves if effort was involved: *Anna was thinking hard whether she had invited Brian*. See section 5.1 for a discussion of modals in embedded questions under 'think.'

Before moving on, two remarks are in order. First, it is not because a given framework allows for the possibility of reducing from Q to P that it will be unable to handle cases of verbs like 'wonder' or 'think,' which we need to compose with unreduced question denotations. Indeed, in Groenendijk and Stokhof, question intensions are available, and in accounts that make use of answerhood operators, one still has access to Hamblin/Karttunen sets of alternatives.[5] Second, our observations here make 'think' an *intensional* verb in the sense of Groenendijk and Stokhof (1984). One might initially be tempted to equate being an intensional verb and being a rogative predicate. For example, 'wonder' is both intensional and rogative; 'know' is both extensional and responsive. 'Think,' however, is intensional and responsive.

Groenendijk and Stokhof argue that being intensional or extensional is partly independent from being rogative or responsive. For them, a verb is extensional if it satisfies the following inference scheme(s), and intensional otherwise:

(9) a. Anna VERBS whether it's raining.
b. It's (not) raining.
∴ Anna VERBS that it's (not) raining.

There are at least two ways in which a verb can be intensional, then. Either it is a verb like 'wonder,' with which we cannot state the conclusion that Anna wonders *that* such and such, because that string is ungrammatical (modulo the 'be amazed at' understanding of 'wonder,' see Karttunen 1977, exx. (12–13)). Or, the verb under scrutiny is responsive, but it does not introduce a relation to the true answer to a question, like 'agree.' For example, the conclusion in (10) does not follow from the premises:

(10) a. Anna and Brian agree whether it's raining.
b. It's raining.
⁄∴ Anna and Brian agree that it's raining.

It will be the case, however, that all rogative predicates are intensional and all interrogative-veridical responsives will be extensional. That non-interrogative-veridcal verbs count as intensional is odd, but acknowledged in the literature: Groenendijk and Stokhof list verbs like 'guess,' 'estimate' and 'wonder,' and Beck and Rullmann (1999) extend a similar treatment to 'agree.'

I am tempted to think that non-interrogative-veridical verbs might still satisfy weaker versions of

[5] If my reading of Karttunen (1977), this is proposed there. The difference between 'wonder' and 'know' stems from the fact that 'know + Q' is related to 'know that' by a meaning postulate.

the inference scheme(s) in (9) and (10), namely, the one given in (11) where the second premise is not stated as a fact, but as the belief of a fact. Here, we see that the conclusion does follow with a verb like 'agree.'

(11) a. Anna and Brian agree whether it's raining.
b. Anna and Brian believe that it's raining.
$\therefore$ Anna and Brian agree that it's raining.

Notice that 'think' is still an odd one out here, as it satisfies neither the stronger nor the weaker inference schemes.

(12) a. Anna is thinking whether she should invite Brian.
b. Anna (believes that) she should invite Brian.
$\not\therefore$ Anna is thinking that she should invite Brian.

The view from inquisitive semantics

In inquisitive semantics, both declaratives and questions are taken to denote sets of propositions. Moreover, these sets are downward closed. For a set of sets B to be downward closed means that if a set A is a member of B all subsets of A are also members of B—the empty set included. Example denotations are provided in (13). I assume again a domain W consisting of 4 worlds and make an arbitrary choice for the maximal element $\{\mathrm{w}_1, \mathrm{w}_2\}$ in the declarative. The rest of the elements in the declarative denotation follow from downward closure. The polar question is made up of the union of the declarative denotation with the denotation of its negation (i.e., the set containing w_3 and w_4, downward closed).

(13) a. $[\![\text{that it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_1\}, \{\mathrm{w}_2\}, \varnothing\}$
b. $[\![\text{whether it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_3, \mathrm{w}_4\}, \{\mathrm{w}_1\}, \{\mathrm{w}_2\}, \{\mathrm{w}_3\}, \{\mathrm{w}_4\}, \varnothing\}$
$= [\![\text{that it's raining}]\!]_{\mathrm{InqSem}} \cup [\![\text{that it's not raining}]\!]_{\mathrm{InqSem}}$

I will follow the practice of superscripting downward closed sets with '$^{\downarrow}$.' The sets in (13) may then alternatively be written as:

(14) a. $[\![\text{that it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}\}^{\downarrow}$
b. $[\![\text{whether it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_3, \mathrm{w}_4\}\}^{\downarrow}$

The main difference between declarative denotations and question denotations is that the former have exactly one maximal element, while the latter have more than one. These maximal elements are also called 'alternatives.'

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We are taught that to know the meaning of a declarative is to know its truth conditions. There is a corresponding way of thinking about the meaning of a question: To know the meaning of a question is to know what counts as an answer to the question, that is, it is to know its answerhood conditions. (This is independent of the knowledge of which answers are, in fact, true.) Accounts that model questions in terms of sets of propositions capture this intuition, inquisitive semantics included, and this is in a sense why the denotation of "whether it's raining" includes the propositions "that it's raining" and "that it's not raining." Downward closure, on the other hand, corresponds to the intuition that any proposition that entails an answer to a question also answers the question and hence should be included in its denotation (entailment, as usual, corresponds to subsethood). Indeed, both someone who knows that it's raining and someone who knows that it's raining and that Brel sang *Laat me niet alleen* know whether it's raining.

One may of course be reluctant to treat declarative meanings as a limiting case of question meanings. It is useful, however, to observe that no information is lost in saying that a declarative now denotes a singleton set of propositions rather than a proposition simpliciter. It is equally useful to point out that even accounts of the semantics of embedded clauses that are not fully framed in the inquisitive setting sometimes make use of a device to shift the meaning of a declarative from a proposition to the singleton set containing it. The device is Partee's (1986) 'IDENT' operation, and the move reduces the need for semantic selectional restrictions in the treatment of responsive predicates (Uegaki, 2015; Roberts, 2018). In the inquisitive setting, selectional restrictions may be done away with altogether because clauses uniformly denote objects of the same type (st)t.

4.1.2 Formal characterizations of states, activities and telic predicates

To be able to proceed, we will also need a characterization of the formal properties that an event predicate of the form $\lambda \mathrm{e}.\phi(\mathrm{e})$ must have to count as a stative vs. non-stative and as atelic vs. telic.

Cumulativity

It is often argued that atelic predicates, as a class, have *cumulative* reference (Krifka, 1989, 1998; Rothstein, 2004). Cumulativity refers to the property defined in (15), which states that if two events

e and e' are in the extension of some predicate P, then so is the mereological sum $\mathrm{e} + \mathrm{e}'$ of the two events.

(15) **Cumulative reference**: P is cumulative iff

$\exists \mathrm{e}, \mathrm{e}'[\mathrm{P}(\mathrm{e}) \wedge \mathrm{P}(\mathrm{e}') \wedge \mathrm{e} \neq \mathrm{e}' \wedge \forall \mathrm{e}, \mathrm{e}'[\mathrm{P}(\mathrm{e}) \wedge \mathrm{P}(\mathrm{e}') \rightarrow \mathrm{P}(\mathrm{e} + \mathrm{e}')]]$

A very intuitive illustration of cumulativity comes from the domain of individual reference (rather than eventualities). Indeed, if one thing is water and another thing is water, those two things together are also water. However, if one thing is a cup of water and another thing is a cup of water, putting those two things together does not yield a cup of water, but two. The claim here is that atelic eventualities (activities and states) are cumulative. That is, if an event e is a run, and an event e' is a run, so is their sum $\mathrm{e} + \mathrm{e}'$. (We can still talk about $\mathrm{e} + \mathrm{e}'$ as being made up of two running events.) Similarly for two states s and s' of knowing Italian and their sum. On the other hand if e is a completed reading of *Tørst* and e' is a completed reading of *Tørst*, $\mathrm{e} + \mathrm{e}'$ are not a completed reading of *Tørst* but two such completed readings.

There might have to be additional restrictions on which eventualities we should expect the sum of to fall under the extension of a predicate. E.g., in addition to having the same participants, they may have to be adjacent temporally (Rothstein 2004). But we need not complicate matters here.

The subinterval property and divisivity

To the best of my knowledge, stative predicates are defined in the literature as ones that have the subinterval property, defined in (16) (Bennett and Partee 1972). This is a property of predicates of times (rather than of predicates of eventualities). The definition states that if a predicate P that has the subinterval property is true at an interval of time t, P is true at all subintervals of t—including, as Bennett and Partee write, at "every moment of time in [t]." (As long as we assume that time is dense, and that we do not pick a moment for t, t is bound to have subintervals—requiring the consequent to be non-vacuously true.)

(16) **Subinterval property**: A predicate of times P has the subinterval property iff

$[\![\mathrm{P}]\!](\mathrm{t}) = 1 \Rightarrow \forall \mathrm{t}' \in \mathrm{t} : [\![\mathrm{P}]\!](\mathrm{t}') = 1$

If I read Bennett and Partee correctly, the original claim is that this property discriminates between atelic and telic predicates, only the former of which have it. That telic predicates do not have the subinterval property can be illustrated with the following example: Consider the time t it takes for

Anna to completely build a house. No proper subinterval of t contains a completed event of building a house. Hence, the predicate of times 'λt.Anna builds a house at t' does not have the subinterval property. Consider now that Brian is happy for duration of time t_1, it intuitively holds that any interval of time included in t_1 is such that Brian is happy at that time. Statives, then, have the subinterval property.

What about activities? If Carolyn ran for duration of time t_2, do all subintervals of t_2 span the duration of a run by Carolyn? The agreed upon answer seems to be that there are subintervals of t_2 that span runs by Carolyn, but that not all subintervals of t_2 are like that. Consider, for instance, any amount of time that measures a single step. Such steps add up to a run, but a single one is not one.

The consequence of these observations is that the subinterval property, as formulated in (16) does uniquely characterize statives, setting them apart from telic predicates on the one hand and from activities on the other. For present purposes, we will not need to know more about the temporal constitution of activities aside from the fact that they do not have the subinterval property (or its counterpart, divisivity).[6]

The counterpart of the subinterval property for predicates of eventualities (as opposed to predicates of times) is the property of having divisive reference, which is defined in (17). The definition states that a predicate of eventualities P that is divisive is such that if it is true of some event e, it is true of all proper subevents of e.

(17) **Divisive reference**: P is divisive iff

$$\exists \mathrm{e}, \mathrm{e}'[\mathrm{P}(\mathrm{e}) \wedge \mathrm{e}' \sqsubset \mathrm{e} \wedge \forall \mathrm{e}[\mathrm{P}(\mathrm{e}) \rightarrow \forall \mathrm{e}'[\mathrm{e}' \sqsubset \mathrm{e} \rightarrow \mathrm{P}(\mathrm{e}')]]]$$

We have considered complete house buildings, being happy, and running as predicates of times above. If we construe them as predicates of eventualities, our intuitions about their internal structure carry over: No subevent of a completed house building is a completed house building. All subeventualities of being happy are eventualities of being happy. And while some subevents of running are also runnings, not all of them are, e.g., the subevent of lifting one's foot or taking a single step, while being integral parts of runnings, are not runnings themselves.

Diagnostics

We are now in a position to decide, based on the formal properties of an eventuality predicate, whether it describes a state, an activity, or something telic: If a predicate of eventualities is divisive

[6] Accurate characterizations seem to rely on partitioning evaluation time into regular intervals and requiring that each cell of the partition contain an instance of the eventuality described (Deo, 2009; Champollion, 2017).

(and cumulative), it is stative. If it is not divisive but cumulative, it is an activity. If it is not cumulative, it is telic—neither an activity nor stative. These properties are summarized in the table in (18).

(18)

aspectual class of predicate	formal properties
stative	divisive and cumulative
activity	not divisive, but cumulative
accomplishment	not divisive and not cumulative

4.2 Capturing the attitude related entailments of 'think'

There are three flavors of attitude reports that will guide us towards the present analysis of 'think,' illustrated in (19). Examples (19a) and (19b) involve declarative belief ascriptions. In the case of (19b), this is possible even though the embedded clause, from which the belief is extracted, is syntactically an interrogative. Example (19c) is different. It does not ascribe a belief to the attitude holder, but rather entails that they are agnostic with respect to the answer to the embedded question and that they are curious, in an intuitive sense, as to what that answer may be.

(19) a. Anna believes that it's raining.

b. Anna knows whether it's raining.

c. Anna wonders whether it's raining.

4.2.1 Doxastic states are not enough

Ascriptions of belief and of agnosticism (part of the meaning of (19c)) can be handled by associating individuals with a set of worlds compatible with their beliefs—their doxastic state—and appropriately relating this set to embedded clause denotations.

In (20), I illustrate one common way of mapping individuals to the set of worlds compatible with their beliefs at a given world. The set 'DOX(x,w)' is x's doxastic or belief state at w.[7]

(20) a. $\mathrm{DOX} = \lambda \mathrm{x}.\lambda \mathrm{w}.\{\mathrm{w}' : \mathrm{w}' \text{ is compatible with what } \mathrm{x} \text{ believes at } \mathrm{w}\}$

b. $\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) = \{\mathrm{w}' : \mathrm{w}' \text{ is compatible with what Anna believes at } \mathrm{w}\}$

[7]There are different ways of making intuitive sense of what it means for a world to be compatible with someone's beliefs and we may discuss how such sets are constructed. Because this is not my main point and because the matter is, depending on how one looks at it, either trivial or very difficult, I refer the reader to, e.g., Heim and Kratzer (1998)—at least for now.

To capture the truth conditions of a sentence like (19a), we say that the subject's belief state is a subset of the set of worlds at which it is raining. This is formalized in (21).

(21) "Anna believes that it's raining" is true at w iff

$$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \subseteq \{\mathrm{w}' : \text{it's raining at } \mathrm{w}'\}$$

With a hypothesis about what it means to believe that something is the case, we can capture the relevant belief entailment of (19b), where *know* composes with an embedded question. Here, we are dealing with a disjunctive belief statement—the sentence is true only if the attitude holder believes an answer to the embedded question. (In the case of *know*, the answer must also be true and, with wh- questions, appropriately exhaustive.)

(22) "Anna knows whether it's raining" is true at w only if

$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \subseteq \{\mathrm{w}' : \text{it's raining at } \mathrm{w}'\}$ or $\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \subseteq \{\mathrm{w}' : \text{it's not raining at } \mathrm{w}'\}$

Finally, we can also capture entailments of agnosticism, as shown in (23). These arise in particular when a verb like *wonder* embeds questions. Here, we are saying that the attitude holder neither believes that it is raining nor that it is not.

(23) "Anna wonders whether it's raining" is true at w only if

$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \not\subseteq \{\mathrm{w}' : \text{it's raining at } \mathrm{w}'\}$ and $\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \not\subseteq \{\mathrm{w}' : \text{it's not raining at } \mathrm{w}'\}$

It is important to see how the relations between belief states and propositions given above correspond to relations between belief states and embedded clause denotations. Take our toy declarative and question denotations from above, repeated in (24).

(24) a. $[\![\text{that it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}\}^{\downarrow}$

b. $[\![\text{whether it's raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_3, \mathrm{w}_4\}\}^{\downarrow}$

To say that Anna believes that it is raining is equivalent to saying that her doxastic state is *a member* of the embedded declarative denotation in (24a). To say that Anna believes that it is raining or that she believes that it is not is to say that her doxastic state is a member of the embedded question denotation in (24b). And to say that she is agnostic is to negate this statement.

(25) a. "Anna believes that it's raining" is true at w iff

$$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \in [\![\text{that it's raining}]\!]_{\mathrm{InqSem}}$$

b. "Anna believes that it's raining or she believes that it isn't" is true at w iff

$$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \in [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$$

c. "Anna neither believes that it's raining nor that it isn't" is true at w iff

$$\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) \notin [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$$

I leave it as an exercise for the reader to check that the statements in (25) are equivalent, respectively, to (21), (22), and (23).

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While they allow us to cover a lot of ground, including with embedded questions, doxastic states and the belief relation are not fine grained enough to capture the notion that one may be curious about (the answer to) a question.

First attitude reports constructed with so-called rogative or inquisitive predicates 'wonder,' 'be curious,' 'ask,' etc., have as a meaning component a statement of agnosticism, but they do not reduce to a statement of agnosticism. That is, it does not suffice to be agnostic about the answer to a question to wonder what its answer is.

(26) Anna wonders whether it's raining.

Entails but is not equivalent to "Anna is agnostic about whether it's raining."

a. wondering entails agnosticism

(i) Anna wonders whether it's raining. #In fact, she doesn't know whether it is. (Redundant.)

(ii) Anna wonders whether it's raining. #And she knows that it is. (Contradictory.)

b. agnosticism does not entail wondering (one may be agnostic and not wonder)

Anna doesn't know whether it's raining. Neither does she wonder whether it is.

A meaning component that inquisitive predicates have in addition to this agnosticism entailment is that the attitude holder is curious about what the answer to the embedded question is. (In some cases, such as with 'ask,' pretense may be involved.)

Second, consider a situation where Anna and Brian believe the same things and are agnostic about the same things. (This amounts to saying that their doxastic states are indistinct from one another.) The two examples in (27) may be true together, which suggests that it is possible for them to be curious about different things despite their sets of beliefs being identical.

(27) a. Anna wonders whether it's raining, but not whether Carolyn defended.

b. Brian wonders whether Carolyn defended, but not whether it's raining.

The analytical implication here is that if a verb like 'wonder' introduced a (non-modal) relation between a doxastic state and a question denotation, the two sentences in (27) would contradict each other. Indeed, we are assuming that Anna and Brian have the same belief state, and that this belief state is both related and not related to each one of the questions given.

4.2.2 Inquisitive states

To model what it means to wonder, then, we either need something in addition to or instead of individuals' doxastic states. I will use the notion of an inquisitive state from work on inquisitive semantics (Ciardelli and Roelofsen, 2015; Ciardelli et al., 2018, a.o.). Formally, an individual's inquisitive state is a set of propositions that is downward closed and whose grand union equals that individual's doxastic state.[8] One way of characterizing INQ(x,w), individual x's inquisitive state at w, is given in (28). I adapt the formulation from Ciardelli et al. (2018). The formal restrictions on INQ(x,w) are repeated in (29).

(28) $\mathrm{INQ}(\mathrm{x}, \mathrm{w}) = \{\mathrm{p} : \mathrm{x}$ would like to believe p as an outcome of inquiry$\}$

(29) INQ(x,w) is a set of propositions such that

a. $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) = \mathrm{DOX}(\mathrm{x}, \mathrm{w})$

b. $\forall \mathrm{p} : \mathrm{p} \in \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \rightarrow \forall \mathrm{q} : \mathrm{q} \subseteq \mathrm{p} \rightarrow \mathrm{q} \in \mathrm{INQ}(\mathrm{x}, \mathrm{w})$

There is a difficulty in characterizing such a set that is similar to characterizing sets of propositions that correspond to beliefs, or sets of possible worlds compatible with what one believes, etc. A concrete example helps, here, I believe. Suppose I go on Google and type 'weather.' This behavior betrays the underlying mental fact that I am curious about what the weather is like, or, to simplify things further, that I am curious about whether it is raining. Given our characterization of INQ, I would then like to form the belief, through inquiry (Google), that it is raining or that it is not raining. That will satisfy my curiosity. We may then write that my INQ is made up of propositions that consist of rainy worlds, and ones that consist of non-rainy worlds.

(30) $\forall \mathrm{p} \in \mathrm{INQ}(\mathrm{Deniz}, \mathrm{w}) : \mathrm{p} \subseteq \{\mathrm{w} :$ it is raining at $\mathrm{w}\} \vee \mathrm{p} \subseteq \{\mathrm{w} :$ it is not raining at $\mathrm{w}\}$

[8] A conceptual difference between doxastic states and inquisitive states is that the former model multiple beliefs held at the same time whereas the latter only model a single question held at a given time.

Not all such propositions will be in my INQ, however. Suppose that it is raining at worlds 1 through 4 and that it is not raining at worlds 5 through 8.

(31) a. $\{\mathrm{w} : \text{it is raining at } \mathrm{w}\} = \{\mathrm{w}_1, \mathrm{w}_2, \mathrm{w}_3, \mathrm{w}_4\}$

b. $\{\mathrm{w} : \text{it is not raining at } \mathrm{w}\} = \{\mathrm{w}_5, \mathrm{w}_6, \mathrm{w}_7, \mathrm{w}_8\}$

Suppose further that I believe that Enschede is in Switzerland and that this proposition is true at worlds 1, 2, 5, 6, and false at worlds 3, 4, 7, 8.

(32) a. $\{\mathrm{w} : \text{Enschede is in Switzerland at } \mathrm{w}\} = \{\mathrm{w}_1, \mathrm{w}_2, \mathrm{w}_5, \mathrm{w}_6\}$

b. $\{\mathrm{w} : \text{Enschede is not in Switzerland at } \mathrm{w}\} = \{\mathrm{w}_3, \mathrm{w}_4, \mathrm{w}_7, \mathrm{w}_8\}$

c. $\mathrm{DOX}(\mathrm{Deniz}, \mathrm{w}) \subseteq \{\mathrm{w}_1, \mathrm{w}_2, \mathrm{w}_5, \mathrm{w}_6\}$

It is clear that if the answer I find to my question of whether it is raining states that it is raining and that Enschede is not in Switzerland, I will reject that answer as false. (Any answer to the question that contradicts my beliefs will suffer the same fate.) Assuming that I do not believe anything else we may then restrict the propositions that I would like to believe as the outcome of my inquiry are of the form:

(33) a. Enschede is in Switzerland and it's raining.

b. Enschede is in Switzerland and it's not raining.

That is, my INQ will be equal to the set of propositions given in (34).

(34) $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{w}) = [\![\text{Enschede is in Switzerland and it's raining}]\!]_{\mathrm{InqSem}} \cup$
$[\![\text{Enschede is in Switzerland and it's not raining}]\!]_{\mathrm{InqSem}}$
$= \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_5, \mathrm{w}_6\}\}^{\downarrow}$

The union of all of these propositions is equal to $\mathrm{DOX}(\mathrm{Deniz}, \mathrm{w})$, which consists of all and only the worlds where Enschede is in Switzerland (1, 2, 5, 6). Intuitively, this corresponds to two facts about inquiry. First, we formulate questions on the basis of our beliefs. Second, we only accept answers to questions that are consistent with our beliefs. (This is of course an idealization in a system where we have not introduced a way of handling belief revision.)

Moreover, this set is downward closed. The intuition behind downward closure can be illustrated as follows. Suppose that a third proposition, that COVID sucks, is true at worlds 1, 4, 5, 8 and

~~undefined elsewhere~~ false at 2, 3, 6, 7.

(35) a. $[\![\text{COVID sucks}]\!] = \{w_1, w_4, w_5, w_8\}$

b. $[\![\text{COVID doesn't suck}]\!] = \{w_2, w_3, w_6, w_7\}$

If Google only volunteers the information that it is raining, my curiosity will be satisfied. But if Google volunteers the information that it is raining and that COVID sucks, my curiosity will also be satisfied. That is, both of the propositions below entail that it is raining, which answers the question of whether it is. (Similar remarks apply to "it's raining and COVID doesn't suck," "it's not raining," "it's not raining and COVID sucks," "it's not raining and COVID doesn't suck.")

(36) a. $\{w_1, w_2\}$ it's raining and Enschede is in Switzerland

b. $\{w_1\}$ it's raining and Enschede is in Switzerland and COVID sucks

Downward closure encodes the information that if one proposition satisfies my curiosity, so do all propositions that entail it.

(37) $\text{INQ}(\text{Deniz}, w) \subseteq [\![\text{whether it's raining}]\!]_{\text{InqSem}}$

$\text{INQ}(\text{Deniz}, w) \subseteq [\![\text{that it's raining}]\!]_{\text{InqSem}} \cup [\![\text{that it's not raining}]\!]_{\text{InqSem}}$

$\text{INQ}(\text{Deniz}, w) \subseteq \{\{w_1, w_2, w_3, w_4\}, \{w_5, w_6, w_7, w_8\}\}^{\downarrow}$

As far as I understand it, this is how one might go about and calculate an individual's inquisitive state in the real world (so to speak), and why inquisitive states are defined with the restrictions given in (29).

With inquisitive states in our toolbox, we are one step closer to characterizing what it means for an individual to wonder, be curious, ask, etc., if something is the case. I follow Theiler et al. (2019) and related papers in writing (38). The truth conditions given are made up of two conjuncts. The first one captures the observation that the sentence entails that the attitude holder is agnostic with respect to the embedded question. The second conjunct captures the intuition that they would like to reach an answer to the embedded question through inquiry.

(38) "Anna wonders whether it's raining" is true at w iff

$\text{DOX}(\text{Anna}, w) \not\subseteq [\![\text{whether it's raining}]\!]_{\text{InqSem}} \wedge \text{INQ}(\text{Anna}, w) \subseteq [\![\text{whether it's raining}]\!]_{\text{InqSem}}$

I will not elaborate further on 'wonder' so as not to postpone the discussion of 'think' for much

longer, but notice that because there are ways of constructing different inquisitive states out of the same doxastic state, the truth conditions in (38) are not equivalent to the ones in (39) even if we assume that $\mathrm{DOX}(\mathrm{Anna}, \mathrm{w}) = \mathrm{DOX}(\mathrm{Brian}, \mathrm{w})$.

(39) "Brian wonders whether it's raining" is true at w iff
$\mathrm{DOX}(\mathrm{Brian}, \mathrm{w}) \notin [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}} \wedge \mathrm{INQ}(\mathrm{Brian}, \mathrm{w}) \subseteq [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$

4.2.3 'Think' introduces the entertain relation

The second conjunct in the truth conditions associated with 'wonder' reports, above, states that the attitude holder's inquisitive state is a subset of the denotation of an embedded clause. This relation is the 'entertain' relation, defined as in (40) (Ciardelli, Groenendijk & Roelofsen 2018, Theiler et al. 2019, Ciardelli & Roelofsen 2015).[9]

(40) x entertains P at w iff $\mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{P}$

As we will see, this relation has the properties that we are looking for in modeling 'think.' Let us then immediately write (41) as well, which states that standing in the entertain relation to a clause P is an entailment of standing in the 'think' relation to P.

(41) x thinks P $\Rightarrow$ x entertains P

In inquisitive semantics, declarative and question denotations are objects of the same type and sentence embedding operators freely compose with declaratives and with questions alike. For the case at hand, then, an individual may stand in the 'think' or the 'entertain' relation to a declarative or to a question ('P,' in (41), could be either). This captures the descriptive fact that 'think' is able to occur with either clause type.

I now turn to the interpretive properties of the entertain relation and show that they get us close to the interpretive facts associated with 'think' when it composes with declaratives, and when it composes with questions.

[9]Despite its name, the entertain relation is not a formalization of the semantics of the natural language expression 'to entertain.' The intuitive motivation behind an individual's inquisitive state as a set of beliefs that one would like to form through inquiry breaks down, it seems, when an individual entertains a declarative.

The declarative case

When P is a declarative, 'x entertains P' entails that x believes P.[10] This is a welcome result. When 'think' composes with a declarative, the resulting attitude report entails that the attitude holder believes the declarative. This observation is repeated in (42), which also suggests that whether 'think' is in a simple tense or, e.g., the progressive does not affect the belief entailment. The continuation in (42b) sounds contradictory after either one of the sentences in (42a).

(42) a. (i) Anna thinks that the pandemic is over.
(ii) Anna is thinking that the pandemic is over.
b. #Even though she believes that it's not.

To see that entertaining a declarative entails believing the declarative, observe first that a clause denotation P is a declarative denotation iff $\bigcup \mathrm{P} \in \mathrm{P}$. This follows from the fact that declarative denotations contain a single maximal element and are downward closed. We now show that for P a declarative denotation, $\mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{P} \Rightarrow \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \in \mathrm{P}$ (with $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) = \mathrm{DOX}(\mathrm{x}, \mathrm{w})$).

Proof:

By definition of $\bigcup$, we have:

(1) $\forall \mathrm{A} : \mathrm{A} \in \bigcup \mathrm{P} \Leftrightarrow \exists \mathrm{B} \in \mathrm{P} : \mathrm{A} \in \mathrm{B}$

(2) $\forall \mathrm{C} : \mathrm{C} \in \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \Leftrightarrow \exists \mathrm{D} \in \mathrm{INQ}(\mathrm{x}, \mathrm{w}) : \mathrm{C} \in \mathrm{D}$

But because $\mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{P}$, by definition of $\subseteq$, we have:

(3) $\forall \mathrm{D}' \in \mathrm{INQ}(\mathrm{x}, \mathrm{w}) : \mathrm{D}' \in \mathrm{P}$

With (3) and (2), we can write:

(4) $\forall \mathrm{C} : \mathrm{C} \in \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \Rightarrow \exists \mathrm{D} \in \mathrm{P} : \mathrm{C} \in \mathrm{D}$

With the $\Leftarrow$ direction of (1) and (4), we have:

(5) $\forall \mathrm{C} : \mathrm{C} \in \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \Rightarrow \mathrm{C} \in \bigcup \mathrm{P}$

(6) $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \bigcup \mathrm{P}$

P is downward closed, so every subset of $\bigcup \mathrm{P}$ is a member of P, in particular $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w})$:

(7) $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \in \bigcup \mathrm{P}$

We have shown that, for declarative P, $\mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{P} \Rightarrow \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \in \mathrm{P}$, or, in other words, that in the declarative case, 'x entertains P' entails that x believes P.[11]

[10] This fact is used to explain why 'wonder' does not embed declaratives (Ciardelli and Roelofsen, 2015; Theiler et al., 2019). The statement that x believes P also entails that x entertains P, which makes the two equivalent for declarative P.

[11] Proofs of this result typically assume more elements of inquisitive semantics. I was after one that only made reference to

The question case

Entertaining a question is compatible with agnosticism When P is a question denotation, 'x entertains P' does not entail belief in any answer to P. To see this, take the question denotation in (43), and assume that w_1 and w_2 are rainy worlds and that w_3 and w_4 are not.

(43) $\mathrm{P} = [\![\text{whether it is raining}]\!]_{\mathrm{InqSem}} = \{\{\mathrm{w}_1, \mathrm{w}_2\}, \{\mathrm{w}_3, \mathrm{w}_4\}\}^{\downarrow}$

The inquisitive state $\mathrm{INQ}(\mathrm{x}, \mathrm{w})_{\mathrm{agnostic}}$ given in (44a) is a subset of P, which means that it makes true the statement that x entertains the question "whether it is raining." But because the union of $\mathrm{INQ}(\mathrm{x}, \mathrm{w})_{\mathrm{agnostic}}$ contains both a rainy world w_1 and a non-rainy world w_3, it is false that x believes that it is raining, and it is false that x believes that it is not raining.

(44) a. $\mathrm{INQ}(\mathrm{x}, \mathrm{w})_{\mathrm{agnostic}} = \{\{\mathrm{w}_1\}, \{\mathrm{w}_3\}, \varnothing\}$

b. $\mathrm{DOX}(\mathrm{x}, \mathrm{w}) = \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w})_{\mathrm{agnostic}} = \{\mathrm{w}_1, \mathrm{w}_3\}$

(i) $\mathrm{DOX}(\mathrm{x}, \mathrm{w}) \notin [\![\text{that it's raining}]\!]_{\mathrm{InqSem}}$

(ii) $\mathrm{DOX}(\mathrm{x}, \mathrm{w}) \notin [\![\text{that it's not raining}]\!]_{\mathrm{InqSem}}$

As we were able to construct a case where x entertains a question and x does not believe any answer to the question, 'x entertains P' does not entail that x believes any answer to P, when P is a question denotation. That is, the entertain relation is compatible with agnosticism.

Entertaining a question does not entail agnosticism When the statement 'x believes P' is true, it is true both that x entertains P and that x entertains Q, for any Q such that $\mathrm{P} \subseteq \mathrm{Q}$. As a consequence, 'x entertains P' does not entail agnosticism, and is merely compatible with it.

Let us first show that $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \in \mathrm{P} \Rightarrow \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \subseteq \mathrm{P}$, that is, that 'x believes P' entails 'x entertains P':

Proof

By assuming that $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \in \mathrm{P}$ and downward closure of P, we have:

(1) $\forall \mathrm{A} : \mathrm{A} \subseteq \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \Rightarrow \mathrm{A} \in \mathrm{P}$

Because $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w})$ is the union of all of the members of $\mathrm{INQ}(\mathrm{x}, \mathrm{w})$:

(2) $\forall \mathrm{B} : \mathrm{B} \in \mathrm{INQ}(\mathrm{x}, \mathrm{w}) \Rightarrow \mathrm{B} \subseteq \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w})$

Chaining (1) and (2) together and by definition of $\subseteq$:

terms from set theory.

(3) $\forall C : C \in \text{INQ}(x, w) \Rightarrow C \in P$

(4) $\text{INQ}(x, w) \subseteq P$

So, if x believes P, then x entertains P. By transitivity of $\subseteq$, for any Q such that $P \subseteq Q$, if $\text{INQ}(x, w) \subseteq P$ then $\text{INQ}(x, w) \subseteq Q$. So if x believes P, x entertains any superset of Q of P.

This makes it possible for there to be contexts in which 'x entertains P' is true, where P is a question denotation, and in which x believes an answer to P. Consider (45a). The inquisitive state given here is one that is constructed only from rainy worlds w_1 and w_2. Hence, the attitude holder believes that it is raining. This inquisitive state is a subset of $P = [\![\text{whether it's raining}]\!]_{\text{InqSem}}$, as given in (43), which means that x also entertains the question 'whether it is raining.'

(45) a. $\text{INQ}(x, w)_{\text{decided}} = \{\{w_1, w_2\}\}^{\downarrow}$

b. $\text{DOX}(x, w) = \bigcup \text{INQ}(x, w)_{\text{decided}} = \{w_1, w_2\}$

$\text{DOX}(x, w) \in [\![\text{that it's raining}]\!]_{\text{InqSem}}$

c. $[\![\text{whether it's raining}]\!]_{\text{InqSem}} = \{\{w_1, w_2\}\}^{\downarrow}$

$\text{INQ}(x, w)_{\text{decided}} \subseteq [\![\text{whether it's raining}]\!]_{\text{InqSem}}$

The entertailment problem

We would like to make use of the conceptualization of inquisitive states as the set of beliefs that an individual would like to reach through inquiry and the observation, made by (44), that 'x entertains P' is compatible with contexts in which x is agnostic about the answer to P to account for the entailments of 'think + Q' given in (46). Indeed, examples like (46) suggest that x is curious and agnostic about the answer to the embedded question.

(46) a. Anna is thinking whether she should invite Brian.

$\rightsquigarrow$ Anna is curious and has not made up her mind.

b. Anna was thinking whether she should invite Brian.

$\rightsquigarrow$ Anna was curious and had not made up her mind.

Because we are hypothesizing that 'x think P' entails that x entertains P, this is going to be possible.

However, we have also seen, surrounding (45), that, for a question denotation P, believing an answer to P entails entertaining P, hence, that it is possible to entertain P without being agnostic about P. We must then ask whether it follows from sentences where 'think' embeds a declarative, e.g., (47a-i), that a corresponding sentence is true where 'think' embeds the polar question formed from

that declarative, e.g., (47a-ii). As shown in (47), the possibility of denying (47a-ii) after asserting (47a-i) suggests that there is no such entailment. (This example is read naturally with stress on 'that' and 'whether.')

(47) a. (i) Anna is thinking that she should invite Brian.
(ii) Anna is thinking whether she should invite Brian.
b. Anna is (simply) thinking that she should invite Brian, and not whether she should invite him.

Call this the 'entertailment problem.' The problem is that we are using the entertain relation to model the behavior of 'think,' but an expectation that arises from the use of entertain is not borne out, namely, that 'think + Q' should be true in contexts where the attitude holder is not agnostic with respect to Q. This problem is attested at least in one other place in the literature, for a Japanese sentential operator 'daroo,' also proposed to introduce the entertain relation in Hara (2018), Uegaki and Roelofsen (2018) and Roelofsen and Uegaki (2020). I comment on 'daroo' in 4.5.2.

The problem is manageable, for us, as we are not hypothesizing that 'think' and 'entertain' are equivalent, only that 'x thinks P' entails 'x entertains P.' To convince ourselves of this, I foreshadow in (48) the form that the truth conditions of thought reports with declaratives and with questions will have. Take f to be an arbitrary function from clause denotations to truth values.

(48) a. Anna is thinking [that she should invite Brian]$_{\phi}$
Anna entertains ϕ
b. Anna is thinking [whether she should invite Brian]$_{?\phi}$
Anna entertains $?\phi$ and $\mathrm{f}(?\phi)$

Here, despite the fact that "Anna is thinking that ϕ" or, equivalently, that "Anna entertains ϕ" will entail that "Anna entertains $?\phi$," it does not follow that (48a) has to entail (48b) as the latter is stronger than the former.[12] The task, of course, will be to define and motivate 'f.' To reiterate, entertaining a declarative ϕ entails entertaining anything weaker than ϕ, and in particular, the polar question $?\phi$. From this, and from including 'entertain' in the definition of 'think,' it does not necessarily follow that thinking a declarative ϕ entails thinking $?\phi$.

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[12]Many thanks to Seth Cable for pushing me to clarify this point.

Before closing this section, however, I would like to point out an interesting fact about the relationship between 'think + Q' and 'think that,' which is brought out by the difference observed between examples (49) and (50). In (49), we see that 'think + Q' is false in a context where it is established that Anna already has a belief about which answer to the question is true.

(49) a. **Context:** Anna is thinking that she should invite Brian.
b. Anna is thinking whether she should invite Brian.
[Judgment in context (49a): False.]

In contrast, the example given in (50) seems to be possible. And this suggests that an eventuality described by 'think + Q' may have eventualities described by 'think that' as its subparts.

(50) As she was thinking whether she should invite Brian, Anna alternated between thinking that she should and thinking that she shouldn't.

Finally when 'think' is placed in a telic frame, a prominent understanding is one where the attitude holder *has* made up their mind. (The unintended understanding is inchoative, that it took her a day to start engaging in thinking whether...) This is illustrated in (51), and further corroborated by the entailment test in (52).

(51) It took Anna a full day to think whether plum trees could grow here.
a. Decided context: Anna believes that plum trees could grow here.
Ex. (51) true.
b. Agnostic context: Anna is unopinionated.
Ex. (51) false.

(52) It took Anna a full day to think whether plum trees could grow here. (#But in the end, she couldn't decide.)

The situation in (52) is consistent with our initial observation that 'think + Q' seems to require the subject's inquisitive state to be agnostic. If this is the case, the observation in (51) is puzzling. For the declaratives to be true, the attitude holder's inquisitive state must be decided, but this would contradict the agnosticism requirement of 'think + Q.'

What is going on here might have something to do with the following intuition: Assume that 'think + Q' requires its subject's inquisitive state to contain more than one alternative, however this

is achieved:

(53) 'think whether p' requires $\mathrm{INQ}_1(\mathrm{x},\mathrm{w}) = \{\mathrm{q}, \neg\mathrm{q}\}^{\downarrow}$ (with $\mathrm{q} \subseteq \mathrm{p}$ and $\neg\mathrm{q} \subseteq \neg\mathrm{p}$)

This inquisitive state has subsets that consist of a single alternative. E.g.,

(54) $\mathrm{INQ}'_1(\mathrm{x},\mathrm{w}) = \{\mathrm{q}\}^{\downarrow}$

An inquisitive state that makes 'think + Q' true, then, is made up of inquisitive states that make 'think that p' true, for p any answer to Q. It might then be possible to access the latter from the former and this would explain the possibility of stringing 'think that' after 'think whether.'

On the other hand, if we start out by asserting that the subject has a stable belief, we must have an inquisitive state that is decided on that belief:

(55) $\bigcup \mathrm{INQ}_2(\mathrm{x},\mathrm{w}) \in \mathrm{p}$

Inquisitive states that meet this requirement cannot be restricted to ones that contain $\neg\mathrm{p}$ as an alternative. The subject has already ruled that possibility out on the basis of their beliefs. This in turn suggests that if one asserts 'think that p,' the requirement imposed by 'think + Q' that the subject's inquisitive state must contain alternatives other than p cannot be satisfied. If this reasoning is on the right track, we may hope to capture these facts by relativizing inquisitive states to events, which I motivate in the next section.

***

In this section, we have seen that the hypothesis that 'think' entails 'entertain,' a relation used to account for the semantics of inquisitive predicates like 'wonder,' yields welcome results with respect to the predicate's attitude related entailments. In particular, the relation is able to capture the fact that 'think' entails belief with declaratives, and can be used to account for the fact that it implies agnosticism and curiosity with embedded questions. This hypothesis is repeated in (56):

(41) x thinks P $\Rightarrow$ x entertains P

To my knowledge, the entertain relation is used in two other places in the literature. First, in modeling the behavior of question directed attitudes like wondering or being curious—these never ascribe belief, like 'think' does with declaratives. Second, it is used in modeling the meaning of particles like Japanese 'daroo,' which I return to in section 4.5.2, which seem to express belief with

declaratives but an attitude akin wondering or being curious with questions (Hara 2018, Uegaki and Roelofsen 2018, Roelofsen and Uegaki 2020). 'Think' reduces to neither of these cases, differing from 'wonder' at least in being able to embed declaratives, and from 'daroo' at least in having event related properties.

4.2.4 Eventuality-relativity of doxastic and inquisitive states

We have been talking about inquisitive states and the entertain relation independently of any eventuality-related properties that they might have. We will now relativize inquisitive states (hence, the entertain relation) to eventualities. This move will help us understand the eventuality related properties of 'think' and of attitude verbs in general.

It is by now standard to relativize attitudes to eventualities (Hacquard, 2006, a.o). The strategy is to first carve out a domain of contentful eventualities (individuals more generally). These are eventualities like believing, wanting or saying—our familiar propositional attitudes—that are a very intuitive sense, associated with information. (It might help to oppose these contentful eventualities to ones like running, drinking, or reading that are not associated with information, or at least not in the same way.) After identifying this class of contentful eventualities, we may talk about their propositional content. We find, for example, (56b) as the truth conditions of a belief report like (56a) (adapted from Hacquard 2006).

(56) a. Darcy believes that it's raining.

b. $\exists \mathrm{s} : \mathrm{belief}(\mathrm{s}, \mathrm{Darcy}) \wedge$ in all worlds w' compatible with the content of s it is raining at w'

These truth conditions state that there is a belief state s, whose holder is Darcy, and whose content is a subset of the possible worlds at which it is raining. The content of a contentful eventuality may be recovered by means of a content function as defined in, e.g., (57):

(57) $\mathrm{f}_{\mathrm{content}} = \lambda \mathrm{e}_{\mathrm{v}} . \lambda \mathrm{w}_{\mathrm{s}} . \mathrm{w}$ is compatible with the content of e

For completeness, I rewrite (56) in (58) by making this content function appear:

(58) a. Darcy believes that it's raining.

b. $\exists \mathrm{s} : \mathrm{belief}(\mathrm{s}, \mathrm{Darcy}) \wedge$ in all worlds w' such that $\mathrm{f}_{\mathrm{content}}(\mathrm{s})(\mathrm{w}')$ it is raining at w'

The properties of declarative attitude reports are most studied in reference to the propositional

content of eventualities, and of individuals more generally, but Rawlins (2013) and Elliott (2017b) are among some authors who relativize interrogatives to eventualities as well. To my knowledge, inquisitive states and the entertain relation are not relativized to eventualities elsewhere in the literature.

***

Let us simply define a function INQ as in (59), as a function from individuals x and eventualities e to a set of propositions. This set of propositions corresponds to x's inquisitive state calculated at e. (I suppress these objects' world arguments as in all of the cases that we will be concerned with, inquisitive states will be calculated at eventualities located at the world of evaluation.)

(59) $\mathrm{INQ} = \lambda \mathrm{x_e}.\lambda \mathrm{e_v}.\{\mathrm{p} : \mathrm{e}$ is an eventuality of x wanting to reach p through inquiry$\}$

Relativizing inquisitive states to eventualities can be motivated with the intuition that when we have a question in mind or behave in a way such that we are seeking the answer to a question, we are talking about eventualities of a certain kind. These take time, have agents (loosely speaking) and, crucially, they involve being related to a question. If, for example, it occurs to me to check whether it is raining, we may call e that event and write (60a). It may then occur to me to check whether the comet Neowise is visible tonight, this is a different event e', related to a different question.

(60) a. $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}) \subseteq [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$

b. $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}') \subseteq [\![\text{whether Neowise is visible}]\!]_{\mathrm{InqSem}}$

As we have seen in section 4.2.3, inquisitive states can be used meaningfully in relation to declarative denotations as well. An example is provided in (61):

(61) $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}'') \subseteq [\![\text{that Stop and Shop is fun}]\!]_{\mathrm{InqSem}}$

This brings us back to the constraint on inquisitive states that their union should equal the doxastic state of an individual, something that we had previously written as '$\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{w}) = \mathrm{DOX}(\mathrm{x}, \mathrm{w})$.' A natural consequence of relativizing inquisitive states to eventualities is that we will now write (62), for e, an arbitrary event.

(62) $\bigcup \mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}) = \mathrm{DOX}(\mathrm{Deniz}, \mathrm{e})$

That is, an individual's doxastic state calculated at an eventuality e is the grand union of that indi-

vidual's inquisitive state calculated at that eventuality.

***

There are many aspects of the idea that doxastic and inquisitive states might be relativized to eventualities that require further thought. For us, these questions pertain to how inquisitive states, calculated for arbitrary individuals and eventualities, should be related to one another.[13]

To illustrate, suppose that we have two inquisitive states $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e})$ and $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}')$ calculated for the same individual, but at (potentially) different eventualities. It does not make sense to assume that these two objects should equal each other, for example, as we may be curious about different things at different occasions (or not curious about anything at all). It does make sense that these objects may be related to one another through the set of belief worlds that they determine. We may require, for example, that an individual's belief state should remain constant and write:

(63) $\forall \mathrm{x} : \forall \mathrm{e} : \forall \mathrm{e}' : \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}) = \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}')$ recall that $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}) = \mathrm{DOX}(\mathrm{x}, \mathrm{e})$

This (hypothetical) constraint would allow for a given attitude holder to form different questions at different occasions, provided that they form them on the basis of the same set of beliefs. This is of course too strong a requirement in the general case, as our beliefs do change, but it might be a good approximation for some cases, e.g., where e and e' are sufficiently close to each other in time.

We have the intuition that different inquisitive states associated with the same individual might have to be related to one another. On the other hand, we could calculate inquisitive states for different individuals and different eventualities, e.g., $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e})$ and $\mathrm{INQ}(\mathrm{Tunç}, \mathrm{f})$.[14] It is unclear that these should be meaningfully related, as there is constancy neither in the questions that distinct individuals might form nor in their beliefs.

We may think of eventualities as having a part whole structure (Champollion and Krifka, 2016, a.m.o.). An event e of running from Northampton to Amherst is made up, for example, of an event e_1 of running from Northampton to a point in Hadley and an event e_2 of running from that point in Hadley to Amherst. With this in mind and turning back to inquisitive states, we may ask the following questions (note that the attitude holder 'x' is kept constant):

Q1 Calculate $\mathrm{INQ}(\mathrm{x}, \mathrm{e})$ for arbitrary x and e. What is the relationship between $\mathrm{INQ}(\mathrm{x}, \mathrm{e})$ and $\mathrm{INQ}(\mathrm{x}, \mathrm{e}')$ for e' a subeventuality of e? (Notation '$\mathrm{e}' \sqsubseteq \mathrm{e}$')

[13] See Elliott (2017a,b) for elements of an algebraic theory of attitudes.

[14] It makes intuitive sense to keep INQ's individual argument constant and have its event argument vary, calculating the same individual's inquisitive state at different eventualities. One might ask whether we should be able to keep INQ's eventuality argument constant while varying its individual argument. That is, are there contentful eventualities that are shared by many holders?

Q2 Calculate $\mathrm{INQ}(\mathrm{x}, \mathrm{e}_1)$ and $\mathrm{INQ}(\mathrm{x}, \mathrm{e}_2)$ for arbitrary x, e_1 and e_2. What is the relationship between $\mathrm{INQ}(\mathrm{x}, \mathrm{e}_1)$, $\mathrm{INQ}(\mathrm{x}, \mathrm{e}_2)$, and $\mathrm{INQ}(\mathrm{x}, \mathrm{e}_1 + \mathrm{e}_2)$, where $\mathrm{e}_1 + \mathrm{e}_2$ corresponds to the mereological sum of e_1 and e_2?

I will only answer these questions partially. For the first question, I propose the following constraint on the relationship between inquisitive states calculated at a given eventuality e and inquisitive states calculated at subeventualities of e—call it 'weak homogeneity.' ('Homogeneity, because inquisitive states calculated at any subeventuality of e are a subset of the same object; 'Weak,' because we are not requiring equality in the consequent.)

(64) **Weak homogeneity**

$$\forall \mathrm{x} : \forall \mathrm{e} : \forall \Phi : \mathrm{INQ}(\mathrm{x}, \mathrm{e}) = \Phi \rightarrow \forall \mathrm{e}' : \mathrm{e}' \sqsubseteq \mathrm{e} \rightarrow \mathrm{INQ}(\mathrm{x}, \mathrm{e}') \subseteq \Phi$$

This constraint states that if x's inquisitive state at e is equal to the set of propositions Φ, x's inquisitive state at any subevent e' of e must be a subset of Φ. (An option here is to take the stronger view that inquisitive states at subeventualities e' is equal to Φ. The formulation given in (64) is the weakest, however, that will work for us.)

An intuitive motivation behind (64) is that, if e is an event at which I am curious about whether it's raining, it seems like we would be willing to say that all of its subevents are ones where I am curious about whether it's raining.

(65) a. $\mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}) = \Phi$ and $\Phi \subseteq [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$

b. $\forall \mathrm{e}' \sqsubseteq \mathrm{e} : \mathrm{INQ}(\mathrm{Deniz}, \mathrm{e}) \subseteq \Phi \subseteq [\![\text{whether it's raining}]\!]_{\mathrm{InqSem}}$

And we would be reluctant to say that there are subevents of e at which I am curious about whether Enschede is in Switzerland, unless this question is relevant for answering the question of whether it is raining.

For the second question Q2 about inquisitive states calculated at two events and their sum, I propose the constraint in (66), which I refer to as cumulativity for inquisitive states.[15]

(66) **Cumulativity for inquisitive states**

$$\forall \mathrm{x} : \forall \mathrm{e}_1 : \forall \mathrm{e}_2 : \forall \Phi : [\mathrm{INQ}(\mathrm{x}, \mathrm{e}_1) \subseteq \Phi \wedge \mathrm{INQ}(\mathrm{x}, \mathrm{e}_2) \subseteq \Phi] \Rightarrow \mathrm{INQ}(\mathrm{x}, \mathrm{e}_1 + \mathrm{e}_2) \subseteq \Phi$$

[15] It might be misleading to call this constraint 'cumulativity,' which would rather go as stated below. Our constraint is a particular case of this, where $\Phi = \Psi$.

$$\forall \mathrm{x} : \forall \mathrm{e}_1 : \forall \mathrm{e}_2 : \forall \Phi : \forall \Psi : [\mathrm{INQ}(\mathrm{x}, \mathrm{e}_1) \subseteq \Phi \wedge \mathrm{INQ}(\mathrm{x}, \mathrm{e}_2) \subseteq \Psi] \Rightarrow \mathrm{INQ}(\mathrm{x}, \mathrm{e}_1 + \mathrm{e}_2) \subseteq \Phi \cup \Psi$$

The constraint states that if inquisitive states calculated at e_1 and e_2 are both subsets of some set of proposition Φ, so is the inquisitive state calculated at $\mathrm{e}_1 + \mathrm{e}_2$. One conceptual motivation for this constraint is that if I am curious about whether it is raining at e_1 and curious about whether it is raining at e_2, then I am also curious about whether it is raining at $\mathrm{e}_1 + \mathrm{e}_2$. That is, I am not suddenly curious about whether Enschede is in Switzerland (without being curious about whether it is raining).

In this section, I hope to have shown that we can relativize inquisitive states to eventualities, and that once we do that, we have to think about how different inquisitive states calculated at different eventualities might relate to one another. The constraints that I have proposed are a first pass approximation that will allow us to model the aspectual behavior of the attitude verbs that we are interested in, and in particular, of 'think.'[16]

4.3 Deriving the state∼activity alternation

We now have a working hypothesis about the attitude related meaning component of 'think.' In this section, we take a closer look at the structure of thinking eventualities. This structure depends on the kind of embedded clause that the predicate composes with. From this we derive the state∼activity alternation conditioned by declarative vs. question complements.

The first conjunct in (67) requires that the attitude holder's inquisitive state remain a subset of P throughout the thinking eventuality. This situation does not change with whether P is a declarative or a question denotation. The second conjunct establishes a dependence between subeventualities of e and subsets of P. If we think that the structure of P is different depending on whether it is a declarative or a question denotation, we will have a handle on why clause type makes a difference in the structure of e.[17]

(67) $\quad [\![\mathrm{think}]\!] = \lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

What we set out to derive is the following—which corresponds to our core generalization about the meaning of 'think,' from section 2.2:

[16] The observant reader will notice that these two constraints contain seeds for stativity.

[17] Is specifying how a thinking eventuality unfolds of interest or use to the formal semanticist? Yes, and for at least two reasons. First, doing so is explanatory. We will understand, for instance, why 'think' is necessarily dynamic with questions, rather than leaving this fact as an accidental property of this verb. Second, we are establishing a relationship between the structure of a thinking eventuality and the structure of *think*'s clausal complement. Such correspondences exist for other attitude verbs as well and by writing them out, we are indicating that they are not entirely idiosyncratic properties of attitude verbs.

(68) a. With a declarative complement P, 'S think P' may be a stative description.

b. With a question complement Q, 'S think Q' is necessarily a non-stative description.

4.3.1 Structuring attitude eventualities: Assumptions

To talk about the eventuality related properties of 'think' we only need to focus on what the predicate entails about the structure of its eventuality argument e. We do not need to know what it means for an individual's inquisitive state to be a subset of a set of propositions P or what it means for an individual to 'evaluate' some proposition p. All we need to know are the formal properties that these predicates satisfy and, in the present case, what the universal quantifier in (69) ranges over depending on whether *think*'s clausal argument is a declarative or a question.

(69) $[\![\text{think}]\!] = \lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

We have already seen, in section 4.2.4, two constraints on the function 'INQ,' which I will review below. We will need to make similar assumptions about the relation 'evaluate.' And we will need to let the contents of the set that f outputs vary depending on whether *think*'s clausal complement P is a declarative or a question. After motivating these assumptions we will turn to whether this predicate is divisive and cumulative depending on different output values for f.

Assumptions about INQ

In section 4.2.4, we have made the following assumptions about the event predicate 'INQ,' which relates an individual and an eventuality to the inquisitive state of that individual at that eventuality.

Our first assumption states that if $\mathrm{INQ}(\mathrm{x},\mathrm{e})$ is equal to Φ, for arbitrary x, e and Φ, the inquisitive state of x calculated at any subevent e' of e has to be a subset of Φ.

(70) **Weak homogeneity**

$\forall \mathrm{x} : \forall \mathrm{e} : \forall \Phi : \mathrm{INQ}(\mathrm{x},\mathrm{e}) = \Phi \rightarrow \forall \mathrm{e}' : \mathrm{e}' \sqsubseteq \mathrm{e} \rightarrow \mathrm{INQ}(\mathrm{x},\mathrm{e}') \subseteq \Phi$

Our second assumption is that 'INQ' is cumulative. That is that if two events e_1 and e_2 relate the same individual to the same set of propositions Φ, so does the mereological sum $\mathrm{e}_1 + \mathrm{e}_2$ of these two events.

(71) **Cumulativity for inquisitive states**

$\forall \mathrm{x} : \forall \mathrm{e}_1 : \forall \mathrm{e}_2 : \forall \Phi : [\mathrm{INQ}(\mathrm{x},\mathrm{e}_1) \subseteq \Phi \wedge \mathrm{INQ}(\mathrm{x},\mathrm{e}_2) \subseteq \Phi] \Rightarrow \mathrm{INQ}(\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2) \subseteq \Phi$

As we will see, these two assumptions will have the effect of making the first conjunct of 'think' divisive and cumulative, and hence, stative.

Assumptions about 'evaluate'

Let us assume that 'evaluate' may not relate a single event to more than one proposition. Let us also assume that if the relation holds between an event e to some proposition p, all subevents e' of e must be related to some subset of p.

(72) a. **'evaluate' satisfies uniqueness of objects**

$$\forall \mathrm{x} : \forall \phi : \forall \psi : \forall \mathrm{e} : [\mathrm{evaluate}(\phi, \mathrm{x}, \mathrm{e}) \wedge \mathrm{evaluate}(\psi, \mathrm{x}, \mathrm{e})] \rightarrow \phi = \psi$$

b. **'evaluate' satisfies mapping to objects**

$$\forall \mathrm{x} : \forall \phi : \forall \mathrm{e} : \forall \mathrm{e}' : [\mathrm{evaluate}(\phi, \mathrm{x}, \mathrm{e}) \wedge \mathrm{e}' \sqsubseteq \mathrm{e}] \rightarrow \exists \phi' [\phi' \subseteq \phi \wedge \mathrm{evaluate}(\phi', \mathrm{x}, \mathrm{e}')]$$

These restrictions make sense if we think of 'evaluate' as establishing a thematic relation between events and propositions, and that thematic relations are constrained. Loosely speaking, if gin is the theme of a drinking event, beer is not the theme of that event, and parts of the drinking have as theme parts of the gin. These restrictions on the relation are directly adapted from Krifka's (1989) 'uniqueness of objects' and 'mapping to objects.'

Assumptions about f

Let $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$ be a possibly empty set of propositions that is calculated based on an embedded clause denotation P and an individual x's doxastic state at e $\mathrm{DOX}(\mathrm{x}, \mathrm{e})$ $(= \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}))$. An intuitive characterization of this set is that it contains parts of P that x is agnostic about.

I will say more on how to calculate the output of f after we derive the aspectual alternation at hand. For now, it suffices to assume that when the clause embedded under 'think' is a declarative, the output of f is empty. When it is a question, the output of f is made up of at least two logically independent propositions. Indeed, if one thinks or is thinking that they should invite Brian, they are not agnostic about that proposition. But if one is thinking whether they should invite Brian, then they *are* agnostic about each one of the two alternatives.

4.3.2 Deriving the stative∼activity alternation

We are assuming that in the declarative case, $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ is empty, and that in the question case, it is a set of at least two independent propositions. Let us now see that the former choice results in a divisive predicate and that the latter, in a non-divisive and cumulative predicate. This is the basis on which the stative∼activity alternation is derived with 'think.'

(73) $[\![\mathrm{think}]\!] = \lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

If the output of f is based on a declarative, the description is divisive

If the restrictor $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ of the universal quantifier in the second conjunct is empty, the conjunct is vacuously true. As assumed, this situation corresponds to the declarative case. To check whether (73) is divisive in this case, we need only to check whether (74) is divisive (for arbitrary x and P), where the second conjunct from (73) has been dropped.

(74) $\lambda \mathrm{e}_{\mathrm{v}}.\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}$

Recall that we assume the following constraint on 'INQ.'

(75) **Weak homogeneity**

$\forall \mathrm{x} : \forall \mathrm{e} : \forall \Phi : \mathrm{INQ}(\mathrm{x},\mathrm{e}) = \Phi \rightarrow \forall \mathrm{e}' : \mathrm{e}' \sqsubseteq \mathrm{e} \rightarrow \mathrm{INQ}(\mathrm{x},\mathrm{e}') \subseteq \Phi$

Consider an arbitrary event e that makes (74) true and an arbitrary set of propositions X such that '$\mathrm{INQ}(\mathrm{x},\mathrm{e}) = \mathrm{X}$.' It follows, from the assertion of (74), that $\mathrm{X} \subseteq \mathrm{P}$. It follows from weak homogeneity that $\forall \mathrm{e}' \sqsubseteq \mathrm{e} : \mathrm{INQ}(\mathrm{x},\mathrm{e}') \subseteq \mathrm{X}$. Because $\mathrm{X} \subseteq \mathrm{P}$ and subsethood is transitive, it follows that $\forall \mathrm{e}' \sqsubseteq \mathrm{e} : \mathrm{INQ}(\mathrm{x},\mathrm{e}') \subseteq \mathrm{P}$. If an event e satisfies (74), all of its subsevents must also satisfy (75), which makes the predicate divisive.

If the output of f is based on a question, the description is not divisive

Let us now assume that f delivers a set of at least two independent propositions. This corresponds to the question case. Let us saturate the clausal and individual arguments of 'think' with arbitrary x and P, thus obtaining (76).

(76) $[\![\mathrm{think}]\!](\mathrm{P})(\mathrm{x}) = \lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

Let us then consider an arbitrary event e that (76) is true of. The first conjunct of (76) will be true of all subevents of e, so we may disregard it throughout. The second conjunct entails that we will find some event ϵ such that ϵ is a subeventuality of e, related to some proposition ϕ in $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$ through the relation 'evaluate.' That is, an event that makes (77) is true, with $\epsilon \sqsubseteq \mathrm{e}$ and $\phi \in \mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$.

(77) $\mathrm{evaluate}(\phi, \mathrm{x}, \epsilon)$

Now we ask whether ϵ has to satisfy (76). To check whether this is the case or not, we need to know what $\mathrm{f}(\mathrm{P}, \mathrm{x}, \epsilon)$ is. I have postponed the definition of f until section 4.3.3 as it is somewhat involved. Here, it suffices to note that f is only sensitive to P and to individual x's doxastic state throughout e. P and x remain constant, and we may assume that so does x's doxastic state. Consequently, we have the equality below, with ϕ, ψ, etc., independent propositions:

(78) $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e}) = \mathrm{f}(\mathrm{P}, \mathrm{x}, \epsilon) = \{\phi, \psi, \ldots\}$

Eventuality ϵ may only satisfy (76) if for every proposition in the set in (78), there is an eventuality ζ such that $\zeta \sqsubseteq \epsilon$ and that ζ is related to that proposition via the relation 'evaluate.'

This is not possible, however, as we have assumed that 'evaluate' satisfies uniqueness of objects and mapping to objects, which are repeated in (79).

(79) a. **'evaluate' satisfies uniqueness of objects**

$\forall \mathrm{x} : \forall \phi : \forall \psi : \forall \mathrm{e} : [\mathrm{evaluate}(\phi, \mathrm{x}, \mathrm{e}) \wedge \mathrm{evaluate}(\psi, \mathrm{x}, \mathrm{e})] \rightarrow \phi = \psi$

b. **'evaluate' satisfies mapping to objects**

$\forall \mathrm{x} : \forall \phi : \forall \mathrm{e} : \forall \mathrm{e}' : [\mathrm{evaluate}(\phi, \mathrm{x}, \mathrm{e}) \wedge \mathrm{e}' \sqsubseteq \mathrm{e}] \rightarrow \exists \phi' [\phi' \subseteq \phi \wedge \mathrm{evaluate}(\phi', \mathrm{x}, \mathrm{e}')]$

Uniqueness of objects guarantees that ϵ will not be related to any proposition other than ϕ. And mapping to objects guarantees that all of ϵ's subevents will be related either to ϕ or to a subset of ϕ. (Uniqueness of objects applies to them as well.) Takn together, these two constraints make it such that there are propositions in $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e}) = \mathrm{f}(\mathrm{P}, \mathrm{x}, \epsilon) = \{\phi, \psi, \ldots\}$ that are not related to ϵ or to its subevents ζ—specifically, all of the propositions independent from ϕ.[18]

As a consequence, with $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$a set of at least two independent propositions, the event predi-

[18]The reason for adopting uniqueness of objects is that if every subevent of e were each related to every proposition in $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$, we would be able to construct homogeneous events that satisfy (76) through and through. Mapping to objects guarantees that the thinking eventuality is 'chunky.' It will be made up of events that are uniformly related to p (or a subset of p), for every p in $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$. This also prevents a counter-intuitive situation from arising whereby an event e' such that $\mathrm{evaluate}(\mathrm{p}, \mathrm{x}, \mathrm{e}')$ could be the subevent of an event e'' such that $\mathrm{evaluate}(\mathrm{q}, \mathrm{e}'')$ for independent p and q. A comparison case is an event of kicking a ball that would have as a subevent an event of kicking, say, a chair.

cate (76) is not and cannot be divisive as the truth of the second conjunct guarantees that we will find a subevent of e that has the properties described for ϵ.

The description is cumulative

To complete our survey of the aspectual properties of the event predicate introduced by 'think,' let us check that the predicate under scrutiny is cumulative, regardless of any particular value of $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$. Take two arbitrary events e_1 and e_2 such that (80) is true of both of them:

(80) $[\![\mathrm{think}]\!](\mathrm{P})(\mathrm{x}) = \lambda \mathrm{e}_{\mathrm{v}}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

The situation is spelled out in (81):

(81) a. $\mathrm{INQ}(\mathrm{x},\mathrm{e}_1) \subseteq \mathrm{P} \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}_1)[\exists \mathrm{e}' \sqsubseteq \mathrm{e}_1[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

b. $\mathrm{INQ}(\mathrm{x},\mathrm{e}_2) \subseteq \mathrm{P} \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}_2)[\exists \mathrm{e}' \sqsubseteq \mathrm{e}_2[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

Now consider whether the predicate in (80) also applies to $\mathrm{e}_1 + \mathrm{e}_2$, that is, whether (82) holds:

(82) $\mathrm{INQ}(\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2) \subseteq \mathrm{P} \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2)[\exists \mathrm{e}' \sqsubseteq \mathrm{e}_1 + \mathrm{e}_2[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

We have assumed that 'INQ' was cumulative, satisfying the condition in (83).

(83) **Cumulativity for inquisitive states**

$\forall \mathrm{x} : \forall \mathrm{e}_1 : \forall \mathrm{e}_2 : \forall \Phi : [\mathrm{INQ}(\mathrm{x},\mathrm{e}_1) \subseteq \Phi \wedge \mathrm{INQ}(\mathrm{x},\mathrm{e}_2) \subseteq \Phi] \Rightarrow \mathrm{INQ}(\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2) \subseteq \Phi$

By assumption, then, we know that the first conjunct in (82) is true. And because every proposition in $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2)$ is related to some part of e_1 and to some part of e_2, it follows that every proposition in $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}_1 + \mathrm{e}_2)$ is related to some part of $\mathrm{e}_1 + \mathrm{e}_2$. Indeed, this sum is made up of nothing but e_1 and e_2. The predicate in (80), then, is cumulative—regardless of whether the set of propositions quantified over is empty or populated.

Interim conclusion

We find that the eventuality predicate used to model the meaning of 'think' varies in whether it is divisive or not depending on the output of f—the restrictor of a universal quantifier over propositions. Regardless of this choice, the predicate is cumulative. When the output of f is determined by a declarative, it is empty, and when it is empty, the resulting eventuality predicate is divisive. As

divisivity is a property of statives, we derive the observation that 'think' is stative with declaratives. When the output of f is determined by a question, it contains at least two independent propositions. In this case, the resulting eventuality predicate is non-divisive. Because the predicate is also cumulative, we derive the observation that 'think' describes an activity with questions.

Addendum: If the output of f is a singleton, we cannot draw a conclusion about divisivity

It is logically possible to have the output of f be a singleton set of propositions. This possibility will not arise given our current assumptions. But I cannot yet rule out the possibility that the case might arise further down the line and include a brief discussion here.

If we assume that the output of f is a singleton, (84) can but need not be a divisive predicate.

(84) $[\![\text{think}]\!](\mathrm{P})(\mathrm{x}) = \lambda \mathrm{e_v}.[\mathrm{INQ}(\mathrm{x},\mathrm{e}) \subseteq \mathrm{P}] \wedge \forall \mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})[\exists \mathrm{e}' \sqsubseteq \mathrm{e}[\mathrm{evaluate}(\mathrm{p},\mathrm{x},\mathrm{e}')]]$

Let e be an arbitrary eventuality that satisfies (84). We may again disregard the first conjunct as it is true throughout e. Now let e' be an arbitrary subeventuality of e. We wish to know whether e' satisfies (84) as well. As the second conjunct relates every proposition to a subeventuality of e but not the other way around, it tolerates the existence of subeventualities of e that are not related to $\mathrm{p} \in \mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$. So we may find an $\mathrm{e}' \sqsubset \mathrm{e}$ such that none of its subeventualities are related to p and this will make (84) not be divisive. It may also happen (accidentally) that all of e's subeventualities are related to p, in which case (84) will be divisive.

This kind of predicate is expected to display an ambivalent behavior—stative in frames that force stativity, dynamic in frames that force dynamicity, and underdetermined otherwise. Down the line, this might help model sentence embedding predicates that alternate in stativity without this alternation being conditioned by clause type (perhaps alternations of the form "Anna remembers/is remembering that the thief had blonde hair").

4.3.3 Calculating the restrictor

The preceding discussion assumed different restrictors for the universal quantifier in *think*'s second conjunct but did not show how to calculate the intended one from the predicate's clausal complement and other arguments. Here, I show how this is achieved.

What we are now after is a function f that will return the intended restrictor based on *think*'s clausal complement and its attitude holder's inquisitive state. Let us again write $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ for the output of this function, as in (85), and proceed towards its definition.

(85) $[\![\text{think}]\!] = \lambda P_{(st)t}.\lambda x_e.\lambda e_v.[INQ(x, e) \subseteq P] \wedge \forall p \in f(P, x, e)[\exists e' \sqsubseteq e[\text{evaluate}(p, x, e')]]$

Sentences like (86a) describe a situation where the attitude holder is evaluating members of a set of propositions. Sentences like (86b), on the other hand, do not describe any such process of evaluation.

(86) a. Anna is thinking whether she should invite Brian.

b. Anna thinks that she should invite Brian.

Let us then formulate the desideratum that with declarative complements P, the output $f(P, x, e)$ should be empty. To determine what the output of $f(P, x, e)$ should be with question complements, we need to characterize the propositions being evaluated in (86a). These propositions are members of the denotation of the embedded question and the attitude holder is agnostic about their truth. We are then selecting from propositions that satisfy (87). (The requirement that a proposition p be a proper subset of $\bigcup INQ(x, e)$ encodes agnosticism about p as it requires there to be non-p worlds in the attitude holder's doxastic state.)

(87) $\forall p : p \in f(P, x, e) \Leftrightarrow p \in P \wedge p \subset \bigcup INQ(x, e)$ (to be revised)

The resulting set will be downward closed because P is downward closed. We do not want $f(P, x, e)$ to be downward closed, however. Someone who is thinking whether they should invite Brian is considering the proposition that they should invite Brian and perhaps some (or every) proposition that is stronger than it ("I should invite Brian and Carolyn," "I should invite Brian and buy some Tito's," and so on.). But this is by no means necessary. Let us then prevent $f(P, x, e)$ from being downward closed. The statement in (88) instructs us to take maximal elements in P and to intersect them with the attitude holder's doxastic state.

(88) $\forall p : p \in f(P, x, e) \Leftrightarrow \exists q \in \text{maximal}(P) : p = q \cap \bigcup INQ(x, e) \wedge p \subset \bigcup INQ(x, e)$

(to be revised)

In the question case, the intersection '$q \cap \bigcup INQ(x, e)$' will always result in a proposition that entails the attitude holder's doxastic state, so the second conjunct is redundant. However, in the declarative case, this is not so. Intersecting a declarative denotation with $\bigcup INQ(x, e)$ always results in $\bigcup INQ(x, e)$ itself. But because this set is not a proper subset of itself, $f(P, x, e)$ is empty, which is what we want.

There is one last requirement to formulate. Examples like (86a) are false in contexts where the attitude holder is already committed to one of the answers (the 'entertailment' problem from section 4.2.3).

(89) a. Context: Anna thinks that she should invite Brian.

b. Sentence: Anna is thinking whether she should invite Brian. [false]

I propose that we could fix this outcome through the definition of f. The situation illustrated in (90) corresponds to the sentence context pair in (89), where P is a question denotation and one alternative of P is not represented in INQ(x,e):

(90) a. $\mathrm{P} = \{\{1\}, \{2\}, \varnothing\}$

b. $\mathrm{INQ}_1(\mathrm{x}, \mathrm{e}) = \{\{1\}, \varnothing\}$

In this case, intersecting $\bigcup \mathrm{INQ}_1(\mathrm{x}, \mathrm{e}) = \{1\}$ with the maximal elements of P results in $\{1\}$ and $\varnothing$. The set $\{1\}$ is not a proper subset of $\mathrm{INQ}_1(\mathrm{x}, \mathrm{e})$ and does not make it into $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$. The empty set is, however, a proper subset of $\{1\}$ and should then make it into $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$. We could prevent this from happening by requiring that for each alternative A in P, intersecting A with $\bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e})$ with A be non-empty.

(91) a. Desideratum: Let there be exactly as many alternatives in INQ as there are alternatives in P.

b. Formalization: $\forall \xi \in \mathrm{maximal}(\mathrm{P})[\xi \cap \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}) \neq \varnothing]$

Let us now put together these properties of f in the definition given in (92). Implementing the desideratum in (91a) by means of a definedness condition, this function f only yields an output if all of the alternatives in P are represented in INQ(x,e). When defined, f returns the set of propositions ϕ that are the weakest members of P that are compatible with the attitude holder's doxastic state and that asymmetrically entail that state.[19]

(92) $\mathrm{f} = \lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}} : \forall \xi \in \mathrm{maximal}(\mathrm{P})[\xi \cap \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}) \neq \varnothing].$
$\{\phi | \exists \psi \in \mathrm{maximal}(\mathrm{P})[\phi = \psi \cap \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e}) \wedge \phi \subset \bigcup \mathrm{INQ}(\mathrm{x}, \mathrm{e})]\}$

[19] I worry that this definition is unnecessarily complicated by the by my commitment to elements of inquisitive semantics, as it involves removing downward closure and counteracting a design feature of relations built on INQ. Conceptually, however, its definition is simple: $\mathrm{f}(\mathrm{P}, \mathrm{x}, \mathrm{e})$ contains all subsets of an embedded clause denotation P that the attitude holder is agnostic about and that are not too strong.

Let us now run through a couple of examples using (92). We consider a declarative case and a polar question case, with inquisitive states that satisfy $\mathrm{INQ}(\mathrm{x},\mathrm{w}) \subseteq \mathrm{P}$. (When $\mathrm{INQ}(\mathrm{x},\mathrm{w}) \not\subseteq \mathrm{P}$, *think*'s first conjunct is false and, hence, the conjunction that defines it.)

- **P a declarative**

  In (93), I provide a declarative P and two sample inquisitive states. Both are subsets of P, INQ_1 is not curious and INQ_2 is curious about whether $\{1\}$ or $\{2\}$ is the case.

(93) a. $\mathrm{P} = \{\{1,2\}\}^{\downarrow}$
  b. $\mathrm{INQ}_1(\mathrm{x},\mathrm{e}) = \{\{1,2\}\}^{\downarrow}$
  c. $\mathrm{INQ}_2(\mathrm{x},\mathrm{e}) = \{\{1\},\{2\}\}^{\downarrow}$

  For both choices of INQ, $\mathrm{DOX}(\mathrm{x},\mathrm{e}) = \{1,2\}$. Intersecting DOX with the unique maximal element of P yields DOX, but DOX does not strictly contain itself, so $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ is empty.

  Under current assumptions, this is what always obtains when P is a declarative.

- **P a polar question**

  In (94), I provide a polar question P and two sample inquisitive states. Both are subsets of P, with INQ_1 curious and INQ_2 not curious about whether $\{1\}$ or $\{2\}$ is the case.

(94) a. $\mathrm{P} = \{\{1\},\{2\}\}^{\downarrow}$
  b. $\mathrm{INQ}_1(\mathrm{x},\mathrm{e}) = \{\{1\},\{2\}\}^{\downarrow}$
  c. $\mathrm{INQ}_2(\mathrm{x},\mathrm{e}) = \{\{1\}\}^{\downarrow}$

  For INQ_1, intersecting DOX(x,e)=$\{1,2\}$ with each maximal element of P returns that maximal element $\{1\}$ and $\{2\}$. Both of these are strict subsets of DOX, so in this case $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e}) = \{\{1\},\{2\}\}$. Notice that the empty set is not a member of this set as $\mathrm{f}(\mathrm{P},\mathrm{x},\mathrm{e})$ is not downward closed.

  For INQ_2, doing the same thing requires us to intersect $\mathrm{DOX} = \{1\}$ with $\{1\}$ and with $\{2\}$ again. But in this case, because $\{1\} \cap \{2\} = \varnothing$, the definedness condition on f is not satisfied and f(P,x,e) is undefined.

4.4 Taking stock

4.4.1 The emerging perspective on question embedding

Once we accept that 'think' combines with embedded questions and grant that 'think wh-' is unacceptable in certain circumstances, for example when the verb is in the simple present, two analytical options emerge. A simplified view of one option is summarized in the table in (95):

(95) Grammaticality of 'think CP' depending on the tense and grammatical aspect of 'think'

	CP is interrogative	CP is declarative
simple tenses	*	✓
progressive tenses	✓	✓

(simplification, to be set aside)

The claim that this table illustrates is that 'think wh-' is ungrammatical in the simple tenses, but grammatical in the progressive tenses, and that 'think that' is grammatical regardless of whether the verb is in a simple or a progressive tense. What matters here is not the distinction between 'simple' and 'progressive' tenses, but rather, that there is a class of tense and aspect combinations in which 'think wh-' is acceptable opposed to a class in which it is not, and that the claim bears on the grammaticality of the relevant constructions.

An alternative is provided in the table in (96). This is what we have been seeing evidence for and what the system sketched out in sections 4.2 and 4.3 provides a way of deriving.

(96) Interpretations of 'think CP' depending on the tense and grammatical aspect of 'think'

	CP is interrogative	CP is declarative
simple present	special interpretations	ongoing state
		special interpretations
progressive tenses	ongoing event	ongoing event
		ongoing state

The claim that this table illustrates—and indeed, my main claim—is that 'think CP' is grammatical, regardless of whether the CP is a declarative or an interrogative, but that it gives rise to different interpretations in different tense and grammatical aspect combinations. Some interpretations (marked 'special interpretations,' and referring to the habitual and to the sportscaster's present) are

perhaps harder to elicit and not ones that were of direct interest, which possibly accounts for the unacceptability and proposed ungrammaticality of 'think wh-' in, e.g., the present simple.

A more focused way of presenting this information is provided in the table in (97). Here, the rows correspond to whether ongoing state or event interpretations are available for 'think CP' depending on whether the CP is interrogative or declarative, and the cells answer 'yes' or 'no.'

(97) Availability of ongoing interpretations for 'think + CP' depending on CP type

	CP is interrogative	CP is declarative
ongoing state	not available	available
ongoing event	available	available

The two tables in (96) and (97) are in fact the reflection of our core generalization from section 2.2, which states that 'think that' may describe states or events but that 'think wh-' may not describe states. In this section, we have started to derive these interpretive differences by letting the clausal argument of 'think' structure the eventuality that it introduces and by constructing, in the declarative case, a stative predicate, and in the interrogative case, a dynamic one.

There are two remarks that are in order here. Whether a given sentence describes an ongoing state, an ongoing event, or whether it has other interpretations of the same kind, this is the contribution of grammatical aspect (and tense). We have been focusing until now on the contribution of lexical aspect—the stativity or dynamicity of 'think' composed with its clausal argument. It is the link between lexical aspect and grammatical aspect that will ultimately account for the patterns that have been summarized in the tables above, and while this project is not directly about grammatical aspect, something has to be said about how it interacts with lexical aspect.

The second remark is that the system that I have sketched out will not derive the full range of facts in table (97) in a unified manner. We understand why 'think wh-' must be dynamic, and that 'think that' may be stative. But I deliver a state of affairs where 'think that' *must* be stative. As it stands, the bottom right cell of the table in (97) is unaccounted for.

In what follows, I will thus briefly touch on composing eventuality descriptions with grammatical aspect and on the particular issue raised by the dynamicity of 'think that.'

4.4.2 Composing event descriptions with grammatical aspect

A simplified view on the interaction between the present simple and the progressive on the one hand, and stativity and dynamicity on the other, is based on paradigms like (98). (The semantics of tense and aspect is notoriously intricate, so the simplification is necessary.) In (98), we see that stative descriptions like 'own a Buick' are acceptable in the present simple but unacceptable in the progressive, while dynamic descriptions like 'cook' are acceptable in the progressive, but unacceptable in the present simple—under an ongoing interpretation.

(98) a. (i) #My father cooks. Cable 2020, ex. (103)
(ii) My father owns a Buick. Cable 2020, ex. (102b)
b. (i) My father is cooking. Cable 2020, ex. (103)
(ii) #My father is owning a Buick. completes Cable's (102b)

Cable's account for the English progressive makes use of a morpheme '$\text{PROG}_{\text{Cable}}$' given in (99)—subscript mine. This is a traditional imperfective morpheme that composes with an eventuality description P to return a predicate of times. It existentially closes the eventuality description and asserts that the runtime $\tau(\text{e})$ of event e that satisfies P includes the reference time t (later to be provided by tense). This captures our intuition that a sentence like "My father is cooking" describes an event that is ongoing now (i.e., the runtime of that event includes now).

(99) $[\![\text{PROG}_{\text{Cable}}]\!] = \lambda \text{P}_{\text{vt}} : \text{P is eventive}.\lambda \text{t}_{\text{i}}.\exists \text{e}[\text{P}(\text{e}) \wedge \text{t} \subseteq \tau(\text{e})]$

What is special about this morpheme is that it comes with a definedness condition, requiring that its eventuality description argument P be eventive.[20] We immediately see that predicates like 'cook' will compose with '$\text{PROG}_{\text{Cable}}$' without a problem, as these predicates are eventive. Sentences like 'My father is cooking,' then, are expected to be possible. On the flip side, composing a predicate like 'own a Buick' with '$\text{PROG}_{\text{Cable}}$' will trigger presupposition failure, as the predicate is stative, or non-eventive. This predicts that 'My father is owning a Buick' should be unacceptable, which is what we observe.

Turning now to the present simple, Cable makes use of the imperfective morpheme defined in (100). This morpheme has the same assertion as '$\text{PROG}_{\text{Cable}}$' that there is an event e that satisfies P

[20] Deo (2009) offers a more elaborate account of the progressive, better equipped to handle cases of progressive statives. At this stage, however, we will be satisfied with a simpler model, and acknowledge the difficulties that that might face. One might also ask whether an alternative treatment is possible, where PROG is left unspecified and there is a special IPFV morpheme with states.

whose runtime $\tau(\mathrm{e})$ includes reference time t. The difference, however, is that IPFV is not restricted to eventive predicates P.[21]

(100) $[\![\mathrm{IPFV}]\!] = \lambda \mathrm{P}_{\mathrm{vt}}.\lambda \mathrm{t}_{\mathrm{i}}.\exists \mathrm{e}[\mathrm{P}(\mathrm{e}) \wedge \mathrm{t} \subseteq \tau(\mathrm{e})]$

Sentences like 'My father owns a Buick' are expected to be able to compose with IPFV, as the predicate is not restricted to any particular lexical aspectual class of predicates. However, so are sentences like 'My father cooks' *under an ongoing event* interpretation. This is contrary to what we observe. Here, Cable's proposal goes as follows: The two sentences in (101) have the same truth conditions

(101) a. [PRES [IPFV [my father cook]]] 'My father cooks'
$\exists \mathrm{e}[\mathrm{cook}(\mathrm{my\ father}, \mathrm{e}) \wedge \mathrm{now} \subseteq \tau(\mathrm{e})]$

b. [PRES [$\mathrm{PROG}_{\mathrm{Cable}}$ [my father cook]]] 'My father is cooking'
$\exists \mathrm{e}[\mathrm{cook}(\mathrm{my\ father}, \mathrm{e}) \wedge \mathrm{now} \subseteq \tau(\mathrm{e})]$ defined only if 'cook' is eventive

We have reasons to think that there is a principle of natural language, Maximize Presupposition, which leads to the result that the structure in (101b) blocks the structure in (101a). The principle requires that if two structures α and β give rise to the same truth conditions, that α additionally has the semantic presupposition ϕ that β does not, and that both α and β are defined and true in a given context, α must be used in that context (Heim, 1991). This is the state of affairs that (101) give rise to: An event predicate with $\mathrm{PROG}_{\mathrm{Cable}}$ gives rise to the same truth conditions as the same predicate with IPFV, but the former comes with the presupposition that the event predicate is eventive. Hence, the structure with the presupposition is to be preferred to the one without.

***

Applying Cable's proposal to 'think CP' yields welcome results, at least up to a certain point. Bearing in mind that, according to the results of sections 4.2 and 4.3, 'think that' is a necessarily stative predicate and 'think wh-,' a necessarily dynamic one, let us see what we predict.

For 'think wh-,' we have to consider the two structures in (102), which respectively correspond to the present progressive and the present simple cases.

(102) a. Anna is thinking whether she should invite Brian
[PRES [$\mathrm{PROG}_{\mathrm{Cable}}$ [Anna think whether she should invite Brian]]]

[21] That PROG should be restricted to eventives rather than IPFV to statives is seen by comparing the interpretation options of statives and eventives in the past simple and progressive.

b. #Anna thinks whether she should invite Brian

[PRES [IPFV [Anna think whether she should invite Brian]]]

The progressive case, in (102a), is correctly predicted to be acceptable under an ongoing event reading: The presupposition introduced by 'PROG$_{\text{Cable}}$,' namely that its complement should be eventive, is satisfied.[22] The present simple case, in (102b), is also correctly predicted to be unacceptable under an ongoing event reading: As Cable's proposal goes, the two sentences have the same assertion—that there is a thinking whether eventuality going on at utterance time—but (102a) is presuppositionally stronger than (102b), which is then blocked by Maximize Presupposition.

Let us now consider the two structures in (103) for 'think that,' corresponding respectively to the present simple and progressive cases.

(103) a. "Anna thinks that she should invite Brian"

[PRES [IPFV [Anna think that she should invite Brian]]]

b. "Anna is thinking that she should invite Brian"

[PRES [PROG$_{\text{Cable}}$ [Anna think that she should invite Brian]]]

This pair requires some thought. First, the sentence in (103b) is predicted to be unacceptable as a case of presupposition failure. Indeed, we have derived 'think that' as a stative predicate, and PROG$_{\text{Cable}}$ presupposes that its complement is eventive. The case is similar to '#My father is owning a Buick.' We will return to this undesirable prediction shortly. Turning to (103a), there is nothing special that happens in the composition: The IPFV morpheme is satisfied with stative predicates and so it is satisfied with 'think that.' Now, because (103b) is ruled out on independent grounds, it does not serve as a presuppositionally stronger alternative to (103a), which is not blocked by Maximize Presupposition.

It seems to me like we can live with this situation for the time being, and the situation is not that surprising. We have operated two simplifications, one is that statives are uniformly unacceptable in the progressive, and the other, that 'think that' is stative. We have then derived that 'think that' should be unacceptable in the present simple—as expected.

***

Ultimately, we will want to work towards a situation where sentences like (103b) are not only

[22] Kristine Yu asks, justly, and I reformulate: How does PROG$_{\text{Cable}}$ know that 'think wh-' is eventive—especially if its (and other predicates') lexical aspectual properties are derived rather than listed? I believe that the answer lies in the possibility that a term like 'eventive' in the formulation of PROG$_{\text{Cable}}$'s presupposition 'P is eventive' is a cover term for 'not divisive.' This can be checked blindly and for arbitrary predicates, regardless of whether their divisivity is primitive or derived.

predicted to be acceptable, but predicted to be acceptable both under an ongoing state and an ongoing event interpretation.[23]

I will simply reiterate the observation here that (some) stative descriptions may occur in the progressive and, in particular, declarative thought reports may be stative and in the progressive. Despite the fact that we might characterize these sentences as contingent statements about the world (the socks, here), subject to change, etc., we have the intuition that they describe ongoing states—in contrast with ongoing activities like "My father is cooking."

(104) My socks are lying on the bed.

'Think that' *also* receives ongoing state interpretations in the progressive, as we have seen in section 2.2.4. Observe, for example, the exchange in (105). The thought report is not describing an activity that Faruk is engaged in, but rather, an opinion that he holds (subject to change, perhaps). The description is stative in this sense, despite being in the progressive.

(105) a. Is Faruk gonna be around this semester?

b. Nah. He's thinking that he might defer.

To account for these and similar examples, we will not be able to use $\text{PROG}_{\text{Cable}}$, which requires that its complement be eventive. One might ask whether this particular requirement could be weakened in such a way that eventive predicates *and* certain stative descriptions are ruled in. Alternatively, Deo (2009) offers a fuller account of the progressive, better equipped to handle the case of progressive statives.

4.4.3 A note on 'think that'

We have seen evidence, in section 2.2.4, that 'think that' alternates between giving rise to a stative and to a dynamic description. To rule in eventive 'think that,' it will not suffice to make finer grained assumptions about grammatical aspect. We have to say something specifically about 'think' composing with declarative complements. Here, I briefly sketch out why it is difficult to derive a stative∼dynamic alternation for 'think that,' and draw one consequence of such alternations on how we model grammatical aspect.

[23]There is a conceptual worry here which is important to flag and leave for a further occasion. The worry is that if (103b) ('thinking that') is no longer ruled out on independent grounds, will it not serve as a presuppositionally stronger alternative to (103a) and block it because of Maximize Presupposition? One way out, here, would be to have eventive 'thinking that' block eventive (and unattested) 'thinks that' and give stative 'thinking that' a different treatment such that it does not interfere with stative 'thinks that.'

Let me illustrate the problem. The verb phrase in (106) apparently alternates between the possibility of describing ongoing states and ongoing events, the former being apparent in the present simple, for example, and the latter, in the progressive. I add an agent oriented adverbial to the progressive here, to bring out the intended reading. (This is just to show that the two interpretations are available in principle, so I do not provide a minimal comparison. If either was unavailable, we would expect attempts to bring it out to give rise to unacceptability.)

(106) [$_{\mathrm{VP}}$ think that Tom Cotton might win]

a. Travis thinks that Tom Cotton might win.

b. Travis is worriedly thinking that Tom Cotton might win.

One way of thinking about this pair of sentences is that the VPs that they contain are derivationally related, that one derives from the other. If this is the case, is the stative construal of the VP derived from a basic dynamic construal, or is its dynamic construal derived from a basic stative construal? The basic issue is that there is not, to my knowledge, any available device to accomplish this derivation in either direction while remaining faithful to the sentences' truth conditions.

Stative descriptions, for example, are habitually derived from dynamic descriptions by using generic or habitual operators (Krifka et al., 1995, a.o.). One hallmark of habituals like (107a) is that they can be paraphrased by sentences with overt frequency adverbials like (107b).

(107) a. Travis works out.

b. Travis usually works out.

However, there is no sense in which the relevant sense of (106a), which involves the ascription of a background belief, is one that is paraphrased by (108).

(108) Travis usually thinks that Tom Cotton might win.

While this is a possible interpretation, it is not the one that we are after. An alternative could be that attitude verbs in the present simple might be 'outside the system,' so to speak. Parentheticality comes to mind (Simons, 2007), which would make it such that the main point of utterances like (106a) is the embedded clause and that the matrix verb perhaps does not contribute an event argument. I will leave a closer look at this option for further research.

The attempt to derive a dynamic description from a basic one faces similar difficulties. (This is

one path that *we* could take, given that the system sketched out here derives a basic stative meaning for 'think that.') A variety of coercion operators may be used to turn stative descriptions into dynamic ones. However, these typically operate on the bounds of the runtime of a state. For instance, the inchoative introduces a start point and the complexive introduces both a start and an end point (Bary, 2009; Homer, 2019). These do not typically operate on the internal constitution of a stative eventuality to turn it into an activity. (An exception might be examples like "Tunç is being Turkish," which can be paraphrased as "acting Turkish." But thinking dynamically that something is the case does not seem to be the same as acting like thinking statively that something is the case.)

We could, on the other hand, reject the idea that one of stative or dynamic guises of 'think that' is derived from the other. There are two possibilities to explore here in further research. One is that there might be two kinds of *that* clauses, one that introduces dynamicity and another that does not. The idea that some embedded clauses are special in that they make reference to events is one that I have explored elsewhere and that might be relevant here (Özyıldız et al., 2018; Demirok et al., 2018; Özyıldız, 2018).

Another possibility is that rather than constructing declarative thought reports that are obligatorily stative, the compositional system sketched out in section 4.3 could deliver an event predicate that is underspecified with respect to stativity in the declarative case (while still being obligatorily dynamic in the question case).

There are other predicates that are not specified with respect to stativity. We will see the case of 'remember' in 5.2.3 as well as one way of making sense of its behavior. The following sentences offer a first look at the fact that 'remember' seems seems to alternate freely between giving rise to stative and dynamic descriptions—even when it embeds questions:

(109) a. I remember who was at your going away party. [state]

b. I'm remembering who was at your going away party. [state or accomplishment]

When 'remember wh-' describes a state, it simply means 'be aware of wh-.' When it describes an accomplishment, the predicate describes a gradual increase of information in the attitude holder's mind. Our intuition about (109b) is that there may be a growing list of names, for example.

We cannot always meaningfully talk about whether a *verb* has such and such lexical aspectual property—as these properties are sometimes determined by a verb taken together with its arguments and modifiers (atelic 'run' or 'drink booch' vs. telic 'run to the park' or 'drink the booch'). We have been seeing that we cannot meaningfully talk about whether verbs like 'think' are stative or dynamic

either—as they alternate depending on the type of their clausal complements. Here we are seeing that we cannot call 'think that' or 'remember wh-' stative or dynamic either: These predicates are not stative, as they can describe events; They are not dynamic either, as they can describe states.

In talking about the progressive, in section 4.4.2, we made use of the morpheme in (110):

(110) $[\![\mathrm{PROG}_{\mathrm{Cable}}]\!] = \lambda \mathrm{P}_{\mathrm{vt}}$: P is eventive.$\lambda \mathrm{t}_{\mathrm{i}}.\exists \mathrm{e}[\mathrm{P}(\mathrm{e}) \wedge \mathrm{t} \subseteq \tau(\mathrm{e})]$

The presupposition that this morpheme introduces requires its complement P to be 'eventive.' Now, 'think that' and 'remember wh-,' in particular, must be taken to satisfy this presupposition, as the predicates are able to occur in the progressive with a dynamic construal. However, we have just seen that we could not call these predicates eventive. There is a tension here.

One may hope to keep to the spirit of presuppositional accounts of the progressive by slightly modifying this presupposition. Let us assume that predicates that are underspecified with respect to stativity are ones that contain both states and events in their extension. Switching briefly to set talk, we might have the following, where σ stands for a state and ϵ:

(111) $[\![\text{X think that}]\!] = \{\ldots, \sigma, \ldots, \epsilon, \ldots\}$

One hypothesis about the progressive is that it restricts an arbitrary eventuality predicate P to a subset of P made up only of events, if there is one. Namely, for (111), we aim for (112):

(112) $[\![\mathrm{PROG}]\!]([\![\text{X think that}]\!]) = \{\ldots, \epsilon, \ldots\}$

I will leave the task of defining such a morpheme to the reader. The general perspective on grammatical aspect that emerges from the discussion of predicates that might be underspecified with respect to stativity, however, is that grammatical aspectual morphemes might serve as a filter—weeding out states (respectively events) from the extension of an underspecified predicate in such a way that only events (respectively states) are visible to the rest of the composition.

4.5 Appendices

4.5.1 Inquisitive states vs. wanting to know

In sections 4.2.1 and 4.2.2, we have seen that doxastic states were not sufficient for capturing the meaning of question-directed attitudes like wondering or thinking a question and that inquisitive

states helped in doing just that. While we do need *something* in addition to ordinary treatments of belief and agnosticism to be able to capture the semantics of inquisitive attitudes, we do not necessarily need to commit to inquisitive states. Here, I review one alternative proposal due to Uegaki (2015) and state my reasons for not adopting it.[24]

Uegaki (2015) proposes to analyze 'wonder' as being equivalent to 'want to know.' According to the proposal, the two sentences in (113) have the same truth conditions:

(113) a. Anna wonders whether it's raining.
b. Anna wants to know whether it's raining.

This move is beneficial, as there are proposals about the meaning of desire predicates that can be put together with the meaning of belief predicates to derive truth conditions for the sentences in (113) (Heim 1992, von Fintel 1999, a.o.).

The fact that the two sentences in (114) could be true together in a context where Anna and Brian have the same doxastic state were meant to illustrate the need for a finer-grained notion of information to capture inquisitive attitudes like wondering.

(114) a. Anna wonders whether it's raining, but not whether Carolyn defended.
b. Brian wonders whether Carolyn defended, but not whether it's raining.

To see how Uegaki's proposal solves the problem raised by (114), observe that the truth conditions of (113b) are roughly as stated in (115).

(115) In all of the worlds compatible with Anna's desires at w, she believes that it's raining or she believes that it's not raining.

Regardless of how individuals' desire worlds are calculated, assuming that two individuals have the same beliefs should not commit them to having the same desires.[25] As a result, we are able to account for the observation that two individuals with the same doxastic state may stand in the 'wonder' relation to different questions because their desires are different. Interesting about this

[24]Rawlins (2013) also offers a treatment of inquisitive content. His treatment is based on a partition semantics for question meanings (Groenendijk and Stokhof, 1984), whereas we have been assuming the sets-of-alternatives based approach used in inquisitive semantics. As far as I can see, the choice between these two ways of modeling inquisitive content does not impact my overall proposal. One inference associated with inquisitive predicates is the notion that attitude holders may be curious about answers to questions. This aspect of the semantics of inquisitive attitude reports are not captured in Rawlins' system in a way that straightforwardly carries over to here.

[25]I do wonder whether a standard assumption that the belief relation is transitive fares well with the fact that an individual's desire worlds are typically taken to be a subset of their belief worlds.

example is that we have not gotten rid of DOX and its relation to embedded question denotations, we have simply displaced the evaluation of that relation to non-actual worlds.

One of the main reasons that Uegaki proposes to analyze 'wonder' as 'want to know' is that he uses the presuppositions of 'want' and of 'know' to derive a contradictory meaning with declaratives, which in turn is meant to explain the fact that 'wonder' does not compose with declaratives.

(116) a. *Anna wonders that it's raining.

b. Interpreted structure for (116a):
Anna [wants [to know [that it's raining]]]

'Want' is often thought to presuppose that the attitude holder does not believe its complement, and believes the presuppositions of its complement (Heim, 1992; von Fintel, 1999). 'Know' is standardly analyzed as presupposing the truth of its complement. Decomposing 'know that p' into 'p and believe that p' (with p presupposed, in addition to being entailed), interpreting (116b) derives the following inferences:

(117) a. Anna believes that it's raining.
[Anna believes the presuppositions of the complement of 'want']

b. Anna does not believe [that it's raining and that she believes that it's raining]
[Anna does not believe the complement of 'want']

Using positive introspection, namely, the assumption that if one believes p, they also believe that they believe p, from (117a) we write:

(118) Anna believes that she believes that it's raining.
[positive introspection and (117a)]

Conjoining (117a) and (118), we get (119):

(119) Anna believes that it's raining and that she believes that it's raining.
[(117a) and (119)]

And this statement contradicts the statement in (117b). Zooming out, we get that when 'want to know' embeds a declarative, the interplay between the presuppositions of 'want' and the presupposition of 'know' derives a contradictory meaning. Hence, 'want to know' does not embed declaratives,

and neither does 'wonder,' under the assumption that the two are equivalent.

Incorporating the literal semantics of desire to our treatment of belief does not yield welcome results for 'think,' however, which is why I do not pursue a direct implementation of Uegaki's proposal here. It is true that sentences like (120) come with the inference that the attitude holder would like to know the answer to the embedded question.

(120) Anna is thinking whether she should invite Brian.

However, Uegaki's 'want to know' analysis is meant to block inquisitive attitude verbs from composing with declaratives. And we do not want to block 'think' from composing with declaratives.

There is also a slight empirical wrinkle in Uegaki's proposal. Declarative embedding under 'want to know' is in fact possible, provided that the factive presupposition associated with 'know' is locally accommodated under 'want.' In short, examples like (121a) *are* acceptable provided that they are interpreted along the lines of (121b).

(121) a. Anna wants to know that it's raining.

b. Anna wants it to rain and to be aware that it's raining. [possible paraphrase of (121a)]

Equating 'wonder' with 'want to know,' then, gives rise to the expectation that 'wonder' should be able to compose with declaratives and give rise to meanings along the lines of (121b). This, however, is contrary to observation.

(122) a. *Anna wonders that it's raining.

b. Anna wants it to rain and to be aware that it's raining. [not a possible paraphrase of (122a)]

4.5.2 Comparing *think* with *mõtlema* and *daroo*

Mõtlema Estonian has a predicate *mõtlema* that has properties similar to *think*: It is described as implying belief with declaratives and contemplation with questions (Roberts 2018). Where the two predicates come apart, however, is that *mõtlema* does not seem to entail belief.

The translations of the examples in (123) motivate the first observation, while example (124) suggests that the belief inference associated with declarative embedding *mõtlema* is cancellable and hence, presumably not an entailment.

(123) a. Liis mõtleb, et sajab vihma.
Liis MÕTLEMA that falls rain
Liis thinks that it's raining. (Roberts, 2018, ex. (4a))

b. Liis mõtleb, kas sajab vihma.
Liis MÕTLEMA Q falls rain
Liis wonders whether it's raining. (Roberts, 2018, ex. (4b))

(124) a. Context: I am discussing with my friend what life would be like if an asteroid had not collided with the earth at the end of the late Cretaceous period.

b. Ma mõtlen, et dinosaurused on ikka elus, kuigi ma tean, et ei ole.
I think that dinosaurs are still alive although I know that NEG be.NEG
"I'm thinking about dinosaurs still being alive, even though I know that they aren't."
(Roberts, 2018, ex. (13))

Roberts does not pursue an analysis of *mõtlema* in terms of entertainment although he does propose that the semantics of similar predicates should be modeled in terms of an information state similar to inquisitive states in that it is compatible with declarative and question denotations alike (his 'contemplation' states).[26]

This is mainly to show that *think* is different from *mõtlema* in that the associated belief inference cannot be relaxed in the cases under scrutiny. Indeed, the example in (125) sounds contradictory, regardless of whether the attitude verb is in a simple or a progressive tense. (This does seem to be possible with 'think about + gerund,' as suggested by the translation in (124).)

(125) #I'm thinking/I think that dinasours are still alive, even though I know they aren't.

The result in (125) contrasts with the observation that there are attitude predicates that do not entail belief, that are acceptable with the continuation given in (124b). 'Imagine' is one, as illustrated in (126).

(126) a. (i) Anna imagines that the pandemic is over.
(ii) Anna is imagining that the pandemic is over.

b. Even though she believes that it's not.

There is, however, a caveat to be made. The pair of sentences in (126a-i) do not entail belief under one understanding, but they do in another. There is a sense in which imagining corresponds to forming a mental picture. This sense is the one evidenced by (126) and does not entail belief. There

[26] See also Roelofsen & Uegaki's (2020) treatment of *mõtlema* as introducing a disjunctive statement 'entertain or imagine.'

is a second, perhaps bleached sense that can however be paraphrased as 'believe.' This is brought out by examples like:

(127) A: Why is everybody outside all of a sudden?
B: I imagine that the pandemic is over.

It is clear that such uses clearly entail belief, although it is unclear to me how this might be derived. I will not attempt to pursue the matter here.

Daroo In the literature, the entertain relation seems originally to be used as an entailment of 'wonder,' alongside the predicate's agnosticism entailment (Ciardelli and Roelofsen, 2015). Unlike 'wonder,' the Japanese particle 'daroo' (also transliterated 'darou') is proposed to denote the entertain relation bare, without any additional entailments (Hara 2018, Uegaki and Roelofsen 2018, Roelofsen and Uegaki 2020).

'Daroo' is a particle that may combine with declaratives or with questions. When it combines with a declarative it conveys belief.[27] When it combines with a question, it at least has the option of conveying an inquisitive attitude. The attitude is anchored to the speaker, unless 'daroo' is embedded under another attitude verb. The situation described is represented in highly schematic form in (128).

(128) a. [that it's raining] daroo
'I believe that it's raining.'
b. [whether it's raining] daroo
'I wonder whether it's raining.'

It is then reasonable to equate the denotation of 'daroo' with the entertain relation. What I would briefly like to draw attention to here is the behavior of this predicate with questions. Because of the interpretation of the entertain relation, 'Q + daroo' is expected to be true in contexts where the speaker believes an answer to the question.

It is unclear whether this expectation is borne out. Uegaki and Roelofsen (2018) write, and I quote:

> Although [the speaker entertaining the issue whether α] is semantically compatible with the speaker believing either α or $\neg\alpha$, it implicates that the speaker is ignorant due to the

[27] This is reported to happen when the declarative has falling intonation. With rising intonation, the meaning is that of a confirmation seeking question. I disregard the latter fact here.

presence of stronger alternatives $[\![\alpha \text{ daroo} \downarrow]\!]$ and $[\![\neg\alpha \text{ daroo} \downarrow]\!]$. [Here, $\downarrow$ indicates falling intonation. DÖ]

This suggests, at best, that 'Q + daroo' is not perfect in contexts where the speaker believes an answer to the question.

Returning to this prediction, Uegaki and Roelofsen (2020) provide the following example to suggest that it is indeed possible for the speaker to utter 'Q + daroo' in a context where they believe an answer to Q. The sentences below are uttered by the same speaker, a question is raised, and then answered.

(129) Huji-santyoo-de-wa mizu-wa nando-de huttoo-suru daroo-ka.
Mt.Fuji-top-loc-top water-top what.degree-in boil-do DAROO-Q
At what temperature does water boil at the top of Mt. Fuji?

Huji-santyoo-de-wa kiatsu-ga tijoo-no sanbunnoni kurai nanode,
Mt.Fuji-top-loc-top air.pressure-nom ground.level-gen two-thirds about because
mizu-wa yaku 87.7 do de huttoo-suru.
water-top about 87.7 °C at boil-do
Since the air pressure there is about 2/3 of the ground level, it boils at about 87.7°C.'

The example contrasts with its counterpart with 'wonder.'

(130) #I wonder at what temperature water boils at the top of Mt. Fuji. Since the air pressure there is about 2/3 of the ground level, it boils at about 87.7°C.

The conclusion drawn from this contrast is that unlike 'wonder,' 'daroo' does not come with an agnosticism entailment.

Satoshi Tomioka (p.c.) reports, however, the intuition that the example in (129) sounds like a question that a teacher would ask. In such contexts, we either do not draw an agnosticism inference or we agree by convention that pretense is involved.

(131) Teacher, to class: "What temperature does water boil at on top of Mt. Fuji?"
$\not\rightarrow$ Teacher is unopinionated about the answer.

If pretense is involved in examples like (129), they might not be enough to show that the semantics of 'Q + daroo' is compatible with the speaker being committed to one of the answers to Q. One could make a similar point with 'ask,' it seems. It is felicitous to report (131) by saying , and similar 'pretense' examples can be constructed with other inquisitive predicates.

(132) a. The teacher asked what temperature water boiled at on top of Mt. Fuji.

b. (My cat usually spills their food.) I wonder who did it this time.

c. (My partner usually makes up the same excuse.) I'm really curious what he's going to say this time.

So, 'ask' does not encode agnosticism in its semantics. But then, the reason that 'ask' is incompatible with declarative complements must be different from why 'wonder' is incompatible with declarative complements. Indeed, with 'wonder' and presumably with other inquisitive predicates, it is the interplay between agnosticism and entertainment that derives their incompatibility with embedded declaratives. Presumably, we would not want to argue that (132) suffices to say that these predicates do not entail agnosticism, and this is the reason why (129) does not suffice either.

The reason that this discussion of 'daroo' is relevant is that 'daroo' and 'think' are similar in that they have overlapping syntactic and semantic properties that we would like to model in terms of entertainment. However, they also suffer from a similar problem: The semantics of entertainment is weaker than what we need for 'daroo' (perhaps) and 'think' when these items compose with questions. Indeed, while an entertainment based semantics leads us to expect that they should be acceptable when the attitude holder believes an answer to the question, this expectation is not straightforwardly borne out.

There are also at least two differences between 'daroo' and 'think.' First, 'daroo' does not appear to be an attitude *verb* per se. Second, and perhaps as a consequence of the first point, 'think' allows us to see aspectual alternations that interact with the syntax and semantics of clausal embedding that 'daroo' does not.

Chapter 5

Spot checks and comparisons

5.1 'Think + Q' ameliorated by embedded modality?

There is an elusive factor that affects the acceptability of sentences where 'think' is combined with embedded questions.[1] The effect of this factor is originally detected in the observation that, at least out of context, some questions embedded by 'think' are more acceptable than others. For example, sentence (1a) is judged to be more acceptable than sentence (1b), and the main difference between the two lies in the material in the embedded questions: The embedded question in (1a) is formed off of a modalized proposition, with 'should,' while the one in (1b) is formed off of an unmodalized one.

(1) a. Anna is thinking whether she should talk to Brian.

b. ?Anna is thinking whether she talked to Brian.

Consistent with the idea that modality might matter is that 'think' unproblematically embeds infinitival questions, which are necessarily modalized (Bhatt, 1999).[2] I do not say more about the force and the flavor of the modal here.

(2) Anna is thinking whether to talk to Brian.

One reason for the unacceptability of 'think wh-' in certain sentences was the attempt to combine

[1] Thanks to everyone who has helped out with judgments and discussion here.

[2] Here lies an interesting point about question embedding 'think.' Bhatt writes that 'all predicates that take infinitival question complements also take finite question complements.' The predicate would be exceptional if one granted that it took infinitival question complements without taking finite ones.

a necessarily dynamic eventuality predicate with tenses and aspects that give rise to special interpretations with dynamic eventuality predicates. 'Think' is in the progressive in both of the examples in (1), which means that nothing should prevent 'think wh-' from describing an ongoing event in (1b) in the same way that it does in (1a). This, in turn, suggests that the contrast in (2) arises for a different reason than considerations about Aktionsart.[3] This section tries to circumscribe the phenomenon in the hope that this might help its future investigators.

With preliminary evidence for such a contrast in mind, it is instructive to return to some of the examples used in the literature to argue for the anti-rogativity of 'think' and 'believe.' Some are given in (3), simplified for presentation and with the asterisk provided by their authors. (We will be working with the material in the embedded questions given, which is why I also include the examples with 'believe' here.)

(3) a. *Bill believes whether/what Mary has eaten. Theiler et al. (2019)
b. *John believes/thinks that Mary left and when she did. Theiler et al. (2019)
c. *John thinks whether Mary drinks. Mayr (2019)
d. *John thought who Bill saw. Grimshaw (1979)

The examples (3a) through (3c) in the present simple do not let the eventivity of 'think wh-' shine through naturally. But even when the matrix verb is changed into 'think' in the progressive, in (4a) through (4d), they remain unacceptable. Grimshaw's example, in (3d) should be unproblematic with respect to the eventivity of 'think wh-,' as eventive predicates are acceptable in the past simple, but it too is degraded and its counterpart in (4e), where 'think' is in the progressive, is unacceptable as well.

(4) a. ?Bill is thinking whether Mary has eaten.
b. ?Bill is thinking what Mary has eaten.
c. ?John is thinking when Mary left.
d. ?John is thinking whether Mary drinks.
e. ?John is thinking who Bill saw.

The unacceptability of the examples in (4) appears to be linked, again, to the material in the embedded questions, rather than to tense and aspect on 'think.' It suffices to modify them slightly, e.g., by adding the modal 'should,' to observe that the sentences improve. The examples in (5) illustrate.

[3]It is interesting to think whether the particular kind of embedded question instantiated in (1b) might force 'think wh-' to be stative, which in turn clashes with the progressive, but this is likely not what is going on in (1).

(5) a. John is thinking whether Mary should drink.

b. John is thinking whether Mary should have drunk.

I do not perform the exercise for all of the sentences and include (5b), with 'should have,' to suggest that the temporal orientation of the embedded modal is not immediately relevant. (Other ways of expressing the future, in English, would have to be looked at as well like 'will,' 'be going to,' 'be about to,' and the futurate present, keeping in mind that some of these expressions might be modal as well. One wonders also about future events whose outcomes are not uncertain such as whether it is possible that a fair coin might land on heads.)

Different from examples that have been used to argue for the anti-rogativity of 'think,' examples of 'think wh-' that are reported as acceptable in the literature feature embedded questions with more material in them. In particular, they contain some kind of modal expression, which potentially contributes to their acceptability. The following examples come from (Dayal, 2016) and White (accepted).

(6) a. I'm thinking whether to invite Bill to the party. Dayal (2016)

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

c. I'm trying to think whether I'd have been a star today or not.

d. That's tough and he started to think whether it was worthwhile to look into other TLDs.

e. And it does cause you to think whether or not it makes sense for us to be here.

f. I was thinking whether there was a way to [. . .] help more than one person.

g. I start to think whether there's an unwritten law for guitarists to never play an interval bigger than the major third.

Without going into detail here, I will note three additional facts. First, the effect does not obtain with questions embedded under responsives, like 'know,' 'remember,' and the like, or under some rogatives like 'wonder.' It does seem to obtain with a class of verbs that includes 'consider,' which the speakers I have asked agreed on, as well as 'weigh,' 'deliberate,' and 'contemplate,' with inter-speaker variation. Second one may ask whether the effect replicates with embedded declaratives, in light of contrasts like (7).

(7) a. I was thinking that I should go to the store.

b. ?I was thinking that I went to the store.

Third, a similar effect replicates in Turkish, with the unmodalized question in (8a) being slightly less acceptable than the modalized one in (8b).[4]

(8) a. ?İsa [öğrencisi mezun ol-du mu diye] düşün-üyor.
İsa his student graduate-PST.PFV Q DIYE think-PRES
İsa is thinking whether his student graduated.

b. İsa [öğrencisi mezun ol-sun mu diye] düşün-üyor.
İsa his student graduate-OPT Q DIYE think-PRES
İsa is thinking whether his student should graduate.

There are at least three reasons for calling this contrast elusive, which I turn to now.

First: Obviating the phenomenon At least some of the same speakers who report that there is a contrast between modalized and unmodalized embedded questions like pairs above also report that the contrast is obviated under different circumstances. Some of these circumstances involve grammatical factors like introducing the embedded question with the preposition 'about' or embedding 'think' under 'try' or in a telic frame like 'take.'

(9) a. Anna is thinking *(about) whether she talked to Brian.

b. Anna is trying to think whether she talked to Brian.

c. It took Anna an hour to think whether she talked to Brian.

Another prominent way that the effect may be obviated is by manipulating contextual factors. If one imagines that figuring out the answer to the embedded question takes effort, is tainted by memory loss, etc., some speakers report that unmodalized embedded questions become acceptable:

(10) **Context**: Anna had one Kriek too many so...
She's thinking whether she talked to Brian.

(11) Anna is thinking where she left her keys.

Second: A variety of ameliorators out of the blue I have biased the presentation of the phenomenon towards the possibility that modals are driving the effect. It is true that a range of modals seem to ameliorate question embedding, but not all of them do. Let us first survey these.

The examples in (12) illustrate with additional root necessity modals—weak ('ought to') and strong ('have to,' 'must'), in the terminology of von Fintel and Iatridou (2008).

[4] Q is a polar question particle and DIYE an introducer of clauses.

(12) Anna is thinking whether she ought to/has to/must talk to Brian.

Epistemic necessity modals might be restricted from occurring in matrix questions (Giannakidou and Mari 2019 and references therein). I do not know whether their behavior in embedded questions has been explored, and this might not be the best place to start.

Possibility modals, both root and epistemic, also give rise to acceptable embedded questions under 'think.' In (13), 'can' can be read as an ability or a deontic modal, and 'might' is read as an epistemic.

(13) a. Anna is thinking whether she can talk to Brian.
b. Anna is thinking whether she might talk to Brian.

Other modal expressions that have an ameliorating effect include the expressions "be possible/okay with/allowed" and the desiderative "want."

In contrast, I have been able to identify at least one kind of modal context that does not seem to give rise to the phenomenon, namely, ability modals that give rise to actuality entailments. Compare, here (14a) and (14b). Both sentences involve an ability modal, but only the former, which gives rise to an actuality entailment (shown in (15)), is odd.

(14) a. ?Anna is thinking whether she was able to lift the piano.
b. Anna is thinking whether she could lift the piano.

(15) a. Anna was able to lift the piano.
$\rightsquigarrow$ Anna lifted the piano.
b. Anna could lift the piano.
$\not\rightsquigarrow$ Anna lifted the piano.

A similar contrast is provided in (16).

(16) a. Anna was thinking whether the dean had allowed her to use the library.
b. ?Anna was thinking whether the card had allowed her to use the library.

Examples (14a) and (16b) might be odd because they imply that the attitude holder is agnostic as to whether they lifted the piano or used the library. These are odd things to be agnostic about—whereas one could be uncertain about their abilities and deans' words can be lengthy and obscure. (Thanks to Seth Cable for discussion here.)

Alongside modal expressions, we also find preferential predicates and degree expressions giving rise to acceptable embedded questions.

(17) a. So I'm not just watching Anne Hathaway singing, I'm thinking whether Anne Hathaway is singing as well as someone else might have sung in the role. [attested online]

b. Anna was thinking whether Brian was tall.

c. Anna was thinking whether she found her her dish tasty.

Third: What is going on? We would ultimately like to understand why certain embedded questions are acceptable under 'think' and why others are not. Here, I set aside one family of phenomena that the facts with 'think' are reminiscent of and mention a couple of ways forward.

One reason for investigating the idea that modality might have the effect of ameliorating question embedding under 'think' comes from the possibile connection with other instances where modals license certain linguistic expressions. For example, free choice 'any' is unacceptable in past episodic sentences, but acceptable (in particular) under the possibility modal 'may' (Aloni, 2007).

(18) a. #Any woman fell.

b. Any woman may fall.

Similarly, degree questions such as (19a) are unacceptable but some modals save the structure, as in (19b) (Fox and Hackl, 2006).

(19) a. *How much radiation did the company not expose its workers to?

b. How much radiation is the company not allowed to expose its workers to?

It seems, however, that these phenomena are too restricted to be likened to the phenomenon that we have been observing with 'think.'

Alternatively, it could be that verbs like 'think' come with lexically specified requirements that certain embedded clauses satisfy and others do not. The deliberative meaning associated with 'think' could manifest itself in the requirement that questions that it embeds must be 'good topics for deliberation.' Rather than a definition, I opt for an illustration: 'Should I talk to Brian?' is, intuitively, a good topic to deliberate about, whereas 'Did I invite Brian?' is less so. It is conceivable that special contexts in which I might have forgotten who is the guest list alleviate the effect ("I must have invited him because I know I invited his partner").[5]

[5]Perhaps the answer has to be at least two steps away, i.e., follow from the answer to a subquestion, or follow from some

Rather than the embedded question introducing topics for deliberation, or, in addition to this, the notion of subjectivity might play a role. There are attitude verbs that are described as being sensitive to whether their declarative complements are subjective (Sæbø, 2009; Coppock, 2018). These include Norwegian 'synes,' Swedish 'tycka,' French 'trouver,' English 'find,' etc.

(20) a. Sophie finds that nuclear power plants are prettier than windmills.

b. #Sophie finds that dinosaurs went extinct 65 million years ago.

There is not a perfect overlap between the kind of embedded clause content that these verbs admit and the kind of embedded question content that 'think' is most happy with. Coppock mentions factual matters, claims about the future, matters of epistemic possibility as unacceptable under Swedish 'tycka.' We have seen, with 'think,' that factual matters were out, whereas the future and epistemic possibility were in.

I would like to formulate here the possibility that subjectivity might be playing a role, but in a sense that is different from the one that intervenes in subjective attitude verbs. A criterion for determining which kinds of embedded questions are acceptable and which are not, which remains to be tested further and possibly refined, is given in (21).

(21) **Solipsism**

'S think Q' presupposes that S can successfully answer Q without consulting any repository of information independent of S's beliefs or desires.

Consistent with this hypothesis, some speakers report that the acceptability of sentences like (22) depend on whether the subject has agency over the outcome of the issue expressed by the embedded question:

(22) I'm thinking whether Lauren earned an A.

a. I'm the grader: ok

b. I'm not the grader: ??

I will not elaborate much further, but a successful analysis of the modal amelioration effect must draw on the semantics of 'think,' world-knowledge associated with thinking events, and meaning components introduced by modals (but not necessarily only by modals).

kind of reasoning.

5.2 The attitude and event related properties of some predicates other than 'think'

Our discussion of the interaction between *think*'s event related and attitude related properties has led to talking about several other attitude predicates. These predicates were mostly mentioned in support or in contrast to the behavior of *think*. Yet, they have attitude and event related properties of their own, which deserve a dedicated discussion. This section contains traces of speculation and many pointers for further research.

5.2.1 Wonder

One of the main questions that arises about 'wonder' is what makes it different from deliberative 'think + Q,' above and beyond the entailments of agnosticism and curiosity shared by the two predicates. There is, of course, the difference that 'wonder' may occur in the present simple with (what looks like) an ongoing state interpretation, whereas 'think + Q' may not. Here, I would like to point out an additional semantic/pragmatic difference between the two predicates that has not, to my knowledge, been observed elsewhere.

'Wonder,' but not 'think,' can often be used to ask questions indirectly—hence the contrast in (23). The sentence in (23a) can be used to raise the question, indirectly, of whether Alice is going to be at the party. The sentence in (23b) does not seem to admit such an interpretation.

(23) a. I was wondering whether Alice was going to be at the party.
   $\rightsquigarrow$ Is Alice going to be at the party?
   b. #I was thinking whether Alice was going to be at the party.
   $\not\rightsquigarrow$ Is Alice going to be at the party?

Similarly, in Turkish, the question in (24a) can be used to ask for someone's name, indirectly, but (24b) cannot be. The former makes use of *merak et-*, which translates 'wonder,' and the latter makes use of *düşün-*, which translates 'think.' Both occurrences of the predicate embed a DP interpreted as a concealed question.

(24) a. İsm-iniz-i merak et-miş-ti-m.
   name-POSS.2P-ACC wonder-PERF-PST-1S
   (i) Lit. I had wondered your name.
   (ii) I had wondered what your name was.

⇝ What's your name?

b. İsm-in-iz-i düşün-müş-tü-m.
name-POSS.2P-ACC think-PERF-PST-1S
(i) Lit. I had thought your name.
(ii) I had tried to figure out what your name was.

(25) a. *İsm-iniz hakkında merak et-miş-ti-m.
name-POSS.2P about wonder-PERF-PST-1S

b. İsm-in-iz hakkında düşün-müş-tü-m.
name-POSS.2P about think-PERF-PST-1S
I had thought about your name.

It is possible here that there is a difference between private and public inquisitive attitudes, and that this is encoded in the difference between 'think + Q' and 'wonder + Q.'

5.2.2 Believe

A predicate that we have not seen much of and without which no discussion of question embedding can be complete is 'believe.' 'Believe' is canonically used to exemplify anti-rogativity, alongside 'think,' with (present simple) examples like (26a). It is known, however, that the predicate embeds questions under certain circumstances, some of which notoriously involve the modal 'can' and negation, as in (26b):

(26) a. *Susan believes which town was obliterated by the meteor.
b. Susan can't believe which town was obliterated by the meteor. (Roberts, 2019)

It is also usually reported that these pieces taken individually do not contribute to making 'believe' compatible with questions (i.e., *doesn't believe wh-, *can believe wh-)—though see Roberts' paper for discussion.

Just like for 'think,' White (accepted) broadens the range of environments in which we find 'believe' with embedded questions. Some of his examples are provided in (27).

(27) a. I struggled to believe whether I could trust the Scriptures.
b. We can choose to believe whether the word of God is true or not.
c. I was torn between believing whether or not Jagex can detect the RSBot client.
d. Believing whether certain individuals within Washington D.C. had an MCA policy is not the same as proving there was such a policy. all from White (accepted), modified

for form

These seem to be unrelated to the "can't believe" cases. A regularity within the set of examples is that 'believe' is not tensed—we have infinitives and gerunds—so we might be tempted to explore whether that has an effect on making 'believe' acceptable with questions as well.[6]

These particular examples are also interesting because they feature 'believe' with polar questions. It is otherwise thought that question embedding 'believe' has properties similar to emotive responsives, which are acceptable with constituent questions but not polar questions:

(28) a. *Susan can't believe whether Ehrenrang was obliterated by the meteor.

(Roberts, 2019)

b. (i) Susan was surprised which town was obliterated by the meteor.

(ii) *Susan was surprised whether Ehrenrang was obliterated by the meteor.

Two observations are in order about White's examples (27c) and (27d). First, about (27c), one can only be torn between at least two things (whereas one can be torn about a single thing). This raises the question of whether the disjunction 'believing whether or not' might in fact be scoping over the attitude verb and creating the illusion of question embedding.

About (27d), I wonder whether the intended meaning of the sentence is rather like (29a), where 'whether' is replaced by 'that,' or like (29b), where the belief ascribed is one or the other answer to the 'whether' question.[7]

(29) a. Believing *that* certain individuals had an MCA policy is not the same as proving that there was such a policy.

b. Believing that certain individuals had an MCA policy or believing that they didn't is not the same as proving that there was such a policy.

If it turns out that the paraphrase is (29a), the example could be likened to other cases where the complementizer 'that' seems to be pronounced as 'whether,' so to speak. Two additional cases are given in (30):

(30) a. I was hoping whether somebody might be able to help me.

[6]Being non-finite might not be sufficient, however: *Jane seems to know/*believe whether she can trust the Scriptures*; *Knowing/*believing whether or not certain individuals had an MCA policy made her upset.*

[7]In the text (pp. 13–14), White seems to be leaning towards paraphrase (29b). The possibility of (29a) has been suggested to me by a linguistically trained native speaker asked about how they interpret the sentence, and by the fact that 'prove' is given a declarative (rather than also a 'whether' clause).

≈ I was hoping that somebody might be able to help me.

modified from White (accepted), section 4.2

b. I doubt whether they serve breakfast here.

≈ I doubt that they serve breakfast here. (Karttunen, 1977; Egré, 2008)

If, on the other hand, that the paraphrase in (29b) is possible, that would cast a doubt on the fact that embedded questions force 'believe' to be dynamic (a possibility which I discuss below), and on the general absence of stative doxastic question embedders that are non-presuppositional (see sections 5.3 and 5.2.3).

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I would like to offer some commentary here on the conditions under which 'believe' is compatible with interrogatives. First, many speakers that I have asked accept sentences like (31a), where 'believe + Q' is inserted in the telic frame 'it took X n time to VP.'

(31) a. It took Anna an hour to believe who she should invite.

b. *It took Anna an hour to believe whether she should invite Brian.

In this frame, it *appears* as though constituent questions are acceptable, while polar questions are out. This initial observation suggests that the range of environments in which 'believe' is acceptable with constituent questions is indeed broader than just under "can't." Here, it would be ideal if we were licensed to say that embedded questions have a similar effect on 'believe' as they have on 'think.' 'Believe + Q' could be an eventuality predicate that is necessarily dynamic, and as witnessed by the contrast between (31a) and (32), perhaps more precisely an achievement predicate.

(32) *Anna was believing who she should invite.

This conclusion is not that easily drawn, however. If 'believe + Q' were an ordinary achievement predicate, we would expect it to be acceptable out of the blue in frames where other achievement predicates are acceptable, for example the simple past. The contrast in (33), however, suggests that this is not the case. (I use 'just' to prevent 'realize' from being read as stative here.)

(33) a. *Anna (just) believed who she should invite.

b. Anna (just) realized who she should invite.

Dynamicity and achievement-hood might then not be sufficient. That is, while 'believe + Q' might necessarily be an achievement predicate, the construction might need additional conditions to be satisfied to be acceptable.

One that comes to mind is based on the observation that some of White's examples indicate that forming a belief about the answer to the embedded question requires effort or conscious decision: "I struggled to believe whether," "We can choose to believe whether," "I was torn between believing whether." Some additional examples attested online also corroborate this possibility:

(34) a. Pyrrho sometimes has a hard time believing whether or not it is butter.
b. Have you ever wrestled with believing whether or not God is actually good.

Another condition comes from the observation that the verb 'believe' has a sense in which 'believe that p' presupposes that there is a claim whose content is p (Roberts, 2020). This is clearly visible when 'believe' takes a DP and a CP argument at the same time:

(35) a. I believe the vet that the cat is pregnant.
$\rightsquigarrow$ The vet claimed that the cat was pregnant.
b. I don't believe the vet that the cat is pregnant.
$\rightsquigarrow$ The vet claimed that the cat was pregnant.

It is possible, then, that question embedding 'believe' is the same beast as the one that we observe in (35). If so, it might be possible to improve bare simple past examples of the form 'S believed wh-' in contexts that make it clear that a relevant claim has been made. I believe that this expectation might be satisfied:

(36) It took some convincing, but Anna finally believed who she should invite.

This particular example, however, does not attempt to tease apart the potential effects of effort from that of the presupposition of a claim. It is furthermore not clear why this would affect the choice of constituent questions over polar questions.[8] A finer grained description of these facts, I must leave for a further occasion.

Underlying, in the present discussion, is the possibility that English 'believe' might be ambiguous.

[8]Paillé and Schwarz (2018) show, however, that there are pragmatic restrictions on uttering sentences with embedded 'whether' questions in contexts where a corresponding embedded declarative could have been used, and that these restrictions do not seem to apply as robustly to constituent questions. One is tempted to explore the possibility that the presupposition of a claim that p might restrict the distribution of 'whether' questions with 'believe.'

Some languages make a distinction between two predicates 'believe.' Turkish has *san-*, which is used to report background beliefs, like the belief that the Earth is round, that there is a pandemic going on, etc. It also has *inan-*, which is used in conjunction with sources of information, like in the English *I believe* you *that the Earth is flat*. These two senses are sometimes difficult to tease apart, in particular when a DP argument is absent, because the second sense of the predicate entails the first (if I believe you that p, I also believe that p). The entailment does not go through the other way around (no one needs to have claimed that p).

(37) a. Suzan [meteorun Ehrenrang'ı yok ettiğini] sanıyor.
Suzan meteor.GEN Ehrengang.ACC destroy.NMZ.ACC SAN.PRES
Suzan believes (≈ thinks) that the meteor destroyed Ehranrang.

b. Suzan [meteorun Ehrenrang'ı yok ettiğine] inanıyor.
Suzan meteor.GEN Ehrengang.ACC destroy.NMZ.DAT INAN.PRES
Suzan believes (it) that the meteor destroyed Ehranrang.

Important for question embedding is that only *inan-* is ever compatible with embedded questions. It is so in conditions similar to English 'believe' and resists polar question embedding as well. The predicate *san-* does not embed questions in similar contexts.[9]

(38) a. *Suzan [meteorun hangi kenti yok ettiğini] san-ama-dı.
Suzan meteor.GEN which town.ACC destroy.NMZ.ACC SAN-MOD.NEG-PST
Intended: Suzan couldn't believe which town the meteor destroyed.

b. Suzan [meteorun hangi kenti yok ettiğine] inan-ama-dı.
Suzan meteor.GEN which town.ACC destroy.NMZ.DAT INAN-MOD.NEG-PST
Suzan couldn't believe which town the meteor destroyed.

c. *Suzan [meteorun Ehrenrang'ı yok edip etmediğine] inan-ama-dı.
Suzan meteor.GEN Ehrenrang.ACC destroy or not.NMZ.DAT INAN-MOD.NEG-PST
*Suzan couldn't believe whether the meteor destroyed Ehrenrang.

Admitting the possibility that the English predicate pronounced 'believe' might correspond to (at least) two distinct semantic objects might, moving forward, help organize and make sense of the range of acceptable and unacceptable cases of question embedding under belief predicates. The picture we are looking at seems indeed to be more complicated than the dichotomy of whether 'believe' embeds questions or not.

[9]It remains to be seen whether *san-* may ever compose with embedded questions. I sense that this might not be possible, but as this dissertation also shows, such an intuition is unreliable. If it does turn out that there are predicates, like *san-*, that never embed questions, either some form of selection or some way of deriving anti-rogativity might be required for some predicates.

5.2.3 Know, remember, and stativity in question embedding

I end these remarks on attitude verbs other than 'think' with a brief discussion of 'know' and 'remember.' These predicates are interesting because the aspectual properties of the eventuality descriptions that they participate in do not seem to be determined by the kind of clause that they compose with. 'Know' robustly gives rise to stative descriptions, as shown in (39).[10]

(39) a. Anna knows that she should invite Brian.
b. Anna knows whether she should invite Brian.

'Remember' alternates between being giving rise to a stative or to an accomplishment predicate independently from the kind of clause that it composes with. This pattern is illustrated with embedded declaratives and embedded questions in (40). It is helpful to imagine the sentences annotated with 'dynamic possible' as describing a gradual change in the attitude holder's mind. I say 'dynamic possible' rather than simply 'dynamic' here, as these examples might admit temporary state readings.

(40) a. (i) Anna remembers that she should invite Brian. [stative]
(ii) Anna is remembering that she should invite Brian. [dynamic possible]
b. (i) Anna remembers who she should invite. [stative]
(ii) Anna is remembering who she should invite. [dynamic possible]

That the dynamic examples are accomplishments is shown by their compatibility with 'in' and incompatibility with 'for' adverbials in addition to their acceptability in the progressive, in (40). The '#' on 'for,' in the examples in (41), should be handled with care, as these examples do admit a reading where a state (of something being present in the mind) holds for 10 minutes. There is not, however, a reading where a process occurs for 10 minutes.

(41) a. Anna remembered that she should invite Brian {#for, in} 10 minutes.
b. Anna remembered who she should invite {#for, in} 10 minutes.

The two broader questions that I would like to touch on through predicates like 'know' and 'remember' are, first, on the kind of variation that we might find in the eventuality related properties of attitude verbs, and, second, on what makes it possible for a predicate to compose with an embed-

[10]It should be noted that 'know' leads an alternative life in examples like *John is knowing all the answers to test questions more and more often* from Binnick (1991). The Turkish predicate *bil-*, which may translate stative 'know,' starts meaning 'guess' in the perfective.

ded question and remain stative. (I will not say anything about what makes a predicate obligatorily stative, or what makes it possible for a predicate to be dynamic with declaratives. I suspect that this might be idiosyncratic.) The second question is particularly interesting for us, because it is the other side of the phenomenon that we have been seeing, with 'think,' where embedded questions force dynamicity.

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The main hypothesis that I would like to suggest is that there is a positive correlation between presuppositionality and the possibility for an attitude verb to remain stative when it embeds questions.

Let us begin by observing that verbs like 'know' and 'remember' are usually listed as factive predicates, meaning that they (usually) presuppose their declarative complements. In contrast, 'think' and 'imagine' neither presuppose nor entail their declarative complements, which makes them non-factive and non-veridical. Let us then hypothesize that all predicates that can be stative with embedded questions are factive.

(42) **Hypothesis** (first pass)

For V a responsive attitude verb, Q a question, and p a declarative:
If the event predicate 'VQ' is able to describe a state, then 'Vp' presupposes p.
(Equivalently: If 'Vp' does not presuppose p, then 'VQ' is not able to describe a state.)

This hypothesis captures the behavior of 'know' and 'remember' (while it remains silent on the difference between the two) and extends to some other predicates like 'understand' and perhaps 'forget.' The hypothesis does not rule out the possibility that there might be factive predicates that are not stative with embedded questions ('figure out,' 'realize' and 'discover' are such examples). Turning briefly to 'think' and 'imagine,' their behavior is also expected. These predicates are non-factive, and hence, they do not have the option of describing states when they embed questions.

This cannot be the whole story, however. There are predicates like 'agree (on)' that can be stative with embedded questions, but that are not factive. These two observations are illustrated in (43).

(43) a. Anna and Brian agree that Carolyn was at the party (but they're wrong).
b. Anna and Brian agree (on) who was at the party.

'Agree (on),' then, falsifies the hypothesis given in (42).

An interesting fact about 'agree (on),' however, is that despite being a non-factive (and non-veridical) predicate, it *is* associated with a presupposition. The sentences given in (44) presuppose that one of the predicate's arguments *believes* the embedded proposition, the individual denoted by the complement of 'with,' in (44a), or part of the plural subject, in (44b) (see also the discussion in Spector and Egré 2015).

(44) a. (i) Anna agrees with Brian that she should invite Carolyn.

(ii) Anna doesn't agree with Brian that she should invite Carolyn.

$\rightsquigarrow$ Brian believes that Anna should invite Carolyn.

b. (i) Anna and Brian agree that she should invite Carolyn.

(ii) Anna and Brian don't agree that she should invite Carolyn.

One of Anna or Brian believes that she should invite Carolyn.

I propose then to reformulate our hypothesis in (42) as in (45).[11]

(45) **Hypothesis** (second pass)

For V a responsive attitude verb, Q a question, and p a declarative:

If the event predicate 'VQ' describes a state, then 'Vp' presupposes...

a. that p is true, or

b. that one of V's individual arguments believes p.

One independent advantage of extending our hypothesis in this way concerns emotive factives, which I'll exemplify with 'be surprised.' Some authors analyze 'be surprised' as factive, as suggested by (46a), which would put it under condition (45a). Crucially, the predicate does have the option of being stative with embedded questions, as suggested by the simple present tense copular construction in (46b).

(46) a. Anna was(n't) surprised that Dave was at the party.

$\rightsquigarrow$ Dave was at the party.

b. Anna is surprised who is the party.

[11] These hypotheses are crucially not about what makes a verb responsive in the first place. 'Be right' is similar to 'agree' in that it seems to presuppose belief, but it does not embed questions (Abusch 2010, cf. Anand and Hacquard 2014, Egré 2008). The notion that factivity or veridicality might play a role in defining the class of responsives is defended in Egré (2008), although see, among others, Mayr (2019), Theiler et al. (2019), and... this dissertation. A notion of veridicality that is relativized to attitude holders is found in Giannakidou (1998), which is similar to the notion used in (45b). I do not know whether this relative notion of veridicality has been harnessed in trying to define the class of responsives.

Other authors analyze emotive factives as merely presupposing that their subject *believes* that their complement is true, citing examples like (47a), from Klein (1975) (see also the discussion in Egré 2008). I provide (47b), to make the comparison possible with (46a). For those speakers that accept examples like (47) (some might find that they are a stretch), they cannot be taken to be factive.

(47) a. Falsely believing that he had inflicted a fatal wound, Oedipus regretted killing the stranger on the road to Thebes. (Klein, 1975, ex. (26))

b. Mistaking Edgar for Dave, who's in quarantine right now, Anna was surprised that Dave was at the party.

Indeed, if (47a) and (47b) respectively presupposed that Oedipus killed the stranger and that Dave was at the party, this would contradict the contextual assumptions that the wound was not fatal and that Dave was not at the party. If these examples only presuppose belief, however, no contradiction arises.[12]

I will end the discussion of the relationship between presuppositionality and stativity on a potential counter-example to the revised hypothesis in (45). The predicate "be certain" is stative with questions but not obviously presuppositional in either one of the two ways stated: It is non-factive and it is not described as presupposing belief. Notice, however, that sentences like (48) do imply that Anna believes that she should invite Brian and asks about her degree of confidence in that belief.

(48) a. Is Anna certain that she should invite Brian?

b. If Anna is certain that she should invite Brian, she'll pick up the phone.

This inference patterns like a presupposition in that it projects from the scope of a polar question operator and the antecedent of a conditional. (Examples where 'be certain' is negated are trickier and deserve further thought.) It is then possible that even a recalcitrant example like 'be certain' might still be brought into the fold. It is also possible that the predicate might be outside the purview of our hypothesis owing to its adjectival nature.

***

I will not offer an explanation of why such a relationship might exist between presupposition and the aspectual properties of eventuality predicates that attitude verbs give rise to when they compose with questions. I will speculate, however. I suspect that when an attitude verb is non-

[12]Klein's example is puzzling because Oedipus does, in fact, kill the stranger Laius.

presuppositional, we must make use of the full set of alternatives that an embedded question provides to structure an attitude eventuality. If that set of alternatives is diverse, so will the internal constitution of the eventuality and we will end up with an object that cannot be a state.

On the other hand, presuppositions might operate on question sets in such a way that these end up being pruned and reduced to the single alternative that is true (via factivity) or to the single alternative that one of the attitude verb's arguments believes (via the presupposition of belief that we have seen with, e.g., 'agree' and emotive factives). In this case, there is only one alternative that may be used to structure the attitude eventuality, making it possible to avoid internal complexity and to end up with an object that can be a state.

***

In what space remains, I will propose a concrete hypothesis about the meaning of 'remember' that will make use of this 'single alternatives' idea—without, however, going through presupposition—to construct an eventuality predicate that may freely alternate between being stative and being an accomplishment.[13]

Consider again the following stative 'remember' reports:

(49) a. Anna remembers that she should invite Brian.
b. Anna remembers whether she should invite Brian.

One way of characterizing the meaning of these reports is that there is a proposition p that is vivid in the attitude holder's mind. In the first sentence, this proposition is the declarative, in the second, it is one of the answers to the embedded question.

Consider now the following dynamic 'remember' reports as uttered, perhaps, by a scientist looking at the attitude holder's brain signals:

(50) a. Anna is remembering that she should invite Brian.
b. Anna is remembering whether she should invite Brian.

One way of characterizing the meaning of these reports is that there is a gradual increase in how vivid a proposition p is in the attitude holder's mind (for p, the declarative or one of the answers to the question). We are in the middle of observing this increase, and we understand that there might

[13]This discussion is more a proof of concept than an attempt to define what it might mean to remember. For more on the linguistic properties of a predicate like 'remember,' see Bondarenko (2019).

be a threshold after which we can say that she *remembers*, in the present simple, that such and such is the case.

Attitude predicates differ in meaning in idiosyncratic ways. Some of the ways in which they differ might be in the kind of attitude they introduce (e.g., in the choice of '$\mathrm{INQ} \subseteq \mathrm{P}$' or '$\bigcup \mathrm{INQ} \in \mathrm{P}$') and some in their dynamic component, if we have good reason to believe that they have one. For instance, the event related properties of 'think' may be shaped by the information encoded by an embedded clause that the attitude holder is agnostic about, but other predicates' event related properties need not be sensitive to agnosticism.

Let us first characterize the attitude related properties of 'remember.' I propose simply that the predicate introduces the relation in (51), familiar from the treatment of predicates that ascribe belief both in the declarative and in the question case.

(51) $\lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.\bigcup \mathrm{INQ}(\mathrm{x},\mathrm{e}) \in \mathrm{P}$ $\qquad (\bigcup \mathrm{INQ}(\mathrm{e},\mathrm{x}) = \mathrm{DOX}(\mathrm{e},\mathrm{x}))$

This is a divisive, hence stative, predicate that asserts that the attitude holder's doxastic state is a member of the embedded clause denotation P. In the declarative case, this amounts to believing that the declarative is true, and in the question case, to believing one of the answers to the question.[14]

Turning now to the eventuality related properties of 'remember,' by taking a detour, through Comrie's (1976: pp. 36–37) comment on the contrast between examples like (52a) and (52b),

(52) a. I understand you.

b. I'm understanding more and more about quantum mechanics as each day goes by. (Comrie, 1976, pp. 36–37)

Comrie writes, and I quote: "In the example given above with the Progressive of *understand*, however, the reference is not to an unchanging state of comprehension, the degree of comprehension being the same from one time-point to another, but rather of a change in the degree of understanding: on any given day, I understood more about quantum mechanics than on any previous day. Thus the verb *understand* here refers not to a state, but to a developing process, whose individual phases are essentially different from one another."

This discussion, in parallel with our observations about 'remember,' suggests that it is not unreasonable to think of the event related components of these attitudes as involving degrees. Doing so also provides a natural way of constructing event predicates that are true both of homogeneous

[14] To be thorough, one way of introducing veridicality into this statement is to restrict P to those of its subsets that contain the evaluation world: $\lambda \mathrm{P}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\lambda \mathrm{e}_{\mathrm{v}}.\lambda \mathrm{w}.\bigcup \mathrm{INQ}(\mathrm{x},\mathrm{e}') \in \{\mathrm{p} : \mathrm{p} \subseteq \mathrm{P} \wedge \mathrm{w} \in \mathrm{p}\}$

eventualities and of eventualities with internal change. Assume, for example, that we may talk about how vivid a proposition is (in someone's mind) by means of the following predicate. Read this as 'e is the state of proposition p being vivid to degree d.'

(53) $\lambda \mathrm{p}_{\mathrm{st}}.\lambda \mathrm{d}.\lambda \mathrm{e}.\mathrm{vivid}(\mathrm{p}, \mathrm{d}, \mathrm{e})$

Suppose that the lexical semantics of 'remember' is of the following form. The first conjunct states that x believes P throughout eventuality e. The second conjunct states that all subevents of e are such that they are states of P being vivid to some degree d. The third conjunct imposes a restriction on the final stage 'fin(e)' of e. There is a degree d_{r} such that P is vivid to that degree. This captures the intuition that a truthful utterance of 'I remember p' involves p being vivid to a degree that exceeds some threshold. I leave this variable unbound and assume that it is contextually determined.[15] The fourth conjunct here states that for any contiguous ('$\triangleleft$') events of P being vivid to some degree d, the degree of vividness associated with the event 'to the left' must be less than or equal to the degree of vividness associated with the event 'to the right.'

(54) $[\![\text{remember}]\!] = \lambda \mathrm{P}.\lambda \mathrm{x}.\lambda \mathrm{e}.$

$$\mathrm{DOX}(\mathrm{x}, \mathrm{e}) \in \mathrm{P} \wedge$$
$$\forall \mathrm{e}' \subseteq \mathrm{e} : \exists \mathrm{d} : \mathrm{vivid}(\mathrm{P}, \mathrm{d}, \mathrm{e}') \wedge$$
$$\mathrm{vivid}(\mathrm{P}, \mathrm{d}_{\mathrm{r}}, \mathrm{fin}(\mathrm{e})) \wedge$$
$$\forall \mathrm{e}_1, \mathrm{e}_2, \mathrm{d}_1, \mathrm{d}_2 : \mathrm{vivid}(\mathrm{P}, \mathrm{d}_1, \mathrm{e}_1) \wedge \mathrm{vivid}(\mathrm{P}, \mathrm{d}_2, \mathrm{e}_2) \wedge \mathrm{e}_1 \triangleleft \mathrm{e}_2 \rightarrow \mathrm{d}_1 \leq \mathrm{d}_2$$

In other words, 'remember' requires the degree to which P is vivid to either remain constant throughout e, or to increase monotonically (though that increase is not necessarily linear).

Now, if e is an eventuality of remembering P and if all of the subevents of e satisfy the property of being vivid to degree d_{r}, that eventuality is homogeneous. On the other hand, if there are subevents of e such that they involve values of vividness strictly smaller than d_{r}, the predicate will not be homogeneous. Indeed, take any subevent e' of e such that it satisfies '$\mathrm{vivid}(\mathrm{P}, \mathrm{d}, \mathrm{e}')$' with $\mathrm{d} < \mathrm{d}_{\mathrm{r}}$. Such a subevent will not make (54) true, because d is strictly smaller than the threshold d_{r}.

Importantly, we were able to construct a predicate of eventualities that is underspecified with respect to whether it is satisfied by eventualities that are homogeneous (states) or by ones that are internally diverse (events). Which of these this kind of predicate ends up describing is determined

[15] Existentially closing it will lead to this predicate being divisive even when there is internal change in degrees of vividness, I believe. But we might ultimately need access to this variable if it is what allows us to say things like 'I remember this more than that.'

by the rest of the structure that it is inserted in, possibly giving rise to ongoing state readings in the present simple, for example, or to ongoing event readings in the progressive (with appropriate assumptions about grammatical aspect).

5.3 Possible and impossible predicates

Spector and Egré (2015) discuss a hypothetical predicate *shknow*, which means 'know' when it embeds declaratives and 'wonder' when it embeds questions. The two kinds of sentences that 'shknow' would give rise to are given in (55), with their hypothesized meaning.

(55) a. John shknows that it is raining.
= John knows that it is raining.
b. John shknows whether it is raining.
= John wonders whether it is raining.

Spector and Egré declare this predicate impossible (unattested, perhaps) and propose a theory of responsivity within which a predicate like *shknow* could not exist. In their thinking, the meaning that a predicate like 'know' gives rise to with embedded questions derives from the meaning that it gives rise to with declaratives. And this is achieved through the application of a rule, which turns a declarative embedding variant of a predicate '$\mathrm{V}_{\mathrm{decl}}$,' in (56), into an interrogative embedding variant '$\mathrm{V}_{\mathrm{int}}$.' (The formulation is (56) is simplified, for the purposes of presentation.)

(56) $[\![\mathrm{V}_{\mathrm{int}}]\!] = \lambda \mathrm{Q}_{(\mathrm{st})\mathrm{t}}.\lambda \mathrm{x}_{\mathrm{e}}.\exists \mathrm{p} : [\![\mathrm{V}_{\mathrm{decl}}]\!](\mathrm{p})(\mathrm{x})$

Given this, we correctly predict that example (57a), where 'know' embeds a question, should have the meaning provided in (57b), which involves two disjoined occurrences of 'know' embedding a declarative. The disjunction corresponds to the existential quantification over the question set given in (56).

(57) a. John knows whether it is raining.
b. John either knows that it is raining or knows that it is not.

And if we assume that the meaning of interrogative embedding 'variants' of responsive predicates derive from their declarative embedding 'variants' by means of an operation like (56), and that this is the only such operation in natural language, we explain the fact that a predicate like *shknow*

seems to be unattested.

Other conceivable but unattested predicates are discussed in Roelofsen and Uegaki (2020) and Steinert-Threlkeld (2020). Roelofsen and Uegaki, in particular, propose that all possible attitude predicates validate the inference in (58). (For present purposes, for 'exhaustivity neutral interrogative' read 'polar question.')[16]

(58) **P-to-Q entailment** Roelofsen and Uegaki (2020)

"[A] clause-embedding predicate *V* is P-TO-Q ENTAILING if and only if for any exhaustivity-neutral interrogative complement *Q*, if there is an answer *p* to *Q* such that ⌜x Vs P⌝, then it also holds that ⌜x Vs P⌝."

We can check that *know* validates this inference, but *shknow* does not: "John knows that it's raining" entails that John knows whether it's raining, but "John shknows (=knows) that it is raining" does not entail that John shknows (=wonders) whether it is raining.

Note first that this constraint is weaker than what we would expect given Spector and Egré's rule in (56), which would require the 'only if' direction of the implication given in (58) to hold as well. Note further that Roelofsen and Uegaki are able to check that attested predicates like 'wonder' also satisfy (a more formal counterpart of) the entailment in (58) even though 'wonder that' is ungrammatical. We will be concerned here with cases where the entailment can be checked through intuition.

***

Roelofsen and Uegaki do talk about counter-examples to their generalization, and here, I would like to add 'think' to the list, noting that the predicate appears to share aspects of meaning with Spector and Egré's *shknow*. (I set aside the occurrences of the predicate in the decisive attitude reports discussed in section 2.3.) With declaratives, 'think' entails belief (cf. knowledge, with 'know') and with questions, the predicate entails agnosticism and curiosity (which are two meaning components associated with 'wonder'). This situation is illustrated in (59):

(59) a. Anna is thinking that she should invite Brian.

b. Anna is thinking whether she should invite Brian.
≈ Anna is wondering whether she should invite Brian.

[16] I thank Tanya Bondarenko here for discussion.

Now, the comparison with *shknow* might seem unwarranted, as there are meaning differences between 'know that' and 'believe/think that' on the one hand, and between 'wonder whether' and 'think whether' on the other. These pertain to veridicality, for the former, and to dynamicity and agentivity, for the latter. However, I believe that *shknow* is originally meant to illustrate a potential gap in the typology of attitude predicates that goes beyond 'know' and 'wonder.' What is banned are predicates that alternate between a non-inquisitive attitude with declaratives and an inquisitive with questions, that is, between a 'know' and 'wonder'-*like* meanings.

Furthermore, 'think' does not validate the P-to-Q entailment, which can be seen in the observation that (59a) does not entail (59b). If the entailment were there, the following sentence would be contradictory—contrary to observation.

(60) Anna is thinking that she should invite Brian, not whether she should invite him.

It is interesting that the alternation in meaning that 'think' is *expected* to give rise to according to Spector and Egré's rule in (56) seems to be unattested more generally (or otherwise hard to observe). Let us illustrate with the hypothetical predicate *shmink*, in (61), which is well-behaved with respect to the rule.

(61) a. John shminks that it's raining.
=John believes that it's raining.
b. John shminks whether it's raining.
=John believes that it's raining or believes that it's not raining.

For example, Turkish and Buryat are two languages that display veridicality alternations in declarative embedding (Özyıldız, 2017a,b; Bondarenko, 2018, 2019). Relevant for us is that a sentence like (62), with the Turkish predicate *bil-* may mean that the attitude holder believes that it is raining (and that they are potentially wrong).

(62) John [yağmur yağdığını] biliyor.
John rain precipitate BIL
Possible reading: John believes that it's raining.

These predicates are compatible with questions. Yet, when they compose with a question, they require that their attitude holder believe its true answer (Özyıldız, 2019).

(63) John [yağmur yağıp yağmadığını] biliyor.
John rain precipitate precipitate.NEG BIL

a. Possible reading: John knows whether it's raining.

b. Not a possible reading: John believes that it's raining or believes that it's not raining.

The situation, otherwise similar from the behavior of the predicate 'tell,' is thus even when we have come to believe that non-veridical question embedding is possible, under predicates like 'be certain' and 'agree.'

I will leave this second observation as a puzzle for now and simply note that if natural language predicates do have a semantics based on the entertain relation, as seen in section 4.2.3, predicates like *shknow* are expected. This is so because the entertain relation is equivalent to belief in the declarative case and is compatible with agnosticism and curiosity in the interrogative case.

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In light of our investigation on the attitude and eventuality related properties of 'think' and of some other attitude predicates, what kinds of predicates *do* we (not) expect to find?

Variation in the attitude related component We have identified two ways in which the attitude related component of an attitude predicate may vary: The predicate may be sensitive to an attitude holder's doxastic state or to the attitude holder's inquisitive state. In the first class of predicates, we may find ones that entail belief both in the declarative and in the question case ('believe that,' 'know that,' 'know wheter'). In the second class of predicates, we may find predicates that are compatible with agnosticism and curiosity in the question case ('think,' 'daroo,' perhaps 'mõtlema').

We have concentrated on two relations between doxastic/inquisitive states and embedded clause denotations. In the inquisitive semantic framework, we have seen cases where individuals' doxastic states were members of embedded clause denotations (which corresponds to belief) and cases where their inquisitive states were subsets of said denotations (which corresponds to entertainment). Different relationships are conceivable here, which would lead to variation in attitude predicates' meaning. For example, if predicates like Slovenian 'dopuščati' have an existential doxastic meaning, we would need to consider this way of relating doxastic states and embedded clause denotations as well (Močnik, 2018). Finally, here, it seems like some predicates' attitude related meaning component may be complex, making reference both to an attitude holder's doxastic and to their inquisitive state. This is the case of 'wonder,' which is proposed to entail agnosticism and entertainment (Theiler et al., 2019, a.o.).

Variation in the eventuality related component In addition to attitude predicates' attitude related meaning component, we have identified that attitude verbs also introduce eventuality related entailments and have made an explicit hypothesis about what these look like for 'think' (extensively) and for 'remember' (briefly).

This eventuality related component contains an element of idiosyncrasy. In defining 'think,' we made use of a predicate *evaluate* (cf. Rawlins 2013 and Roberts 2018, who make use of the notion of *contemplation*) and in defining 'remember,' we made reference to *how vivid* a belief is. These aspects of the meaning of attitude verbs are similar to (regular) dictionary definitions of words and they might vary without reason from verb to verb.[17]

This component was shown to have formal properties as well, as it involved quantification over subsets of embedded clause denotations and over parts of eventualities, all of which possibly interacts with semantic properties of attitude verbs like presupposition. The range of variation here concerns the ways in which embedded clause denotations may be used to structure attitude eventualities: Can we freely construct states, activities, accomplishments, etc., from declarative and question denotations? Or are our options limited? In what follows, I would like to dedicate some time to the concrete exercise listing some kinds of attitude verbs that we find, and some kinds that we do not. We will find that our options are limited, and I will leave the task of refining my preliminary observations and explaining them for further work.

We have come across several attitude predicates with distinct 'lexical aspectual profiles.' In addition to 'think,' which is stative or dynamic with declaratives and only dynamic with questions, I have mentioned 'know,' which is uniformly stative, 'figure out,' which is uniformly dynamic, and 'remember,' which alternates freely between being stative or dynamic regardless of embedded clause type. (I will not distinguish between different kinds of dynamic predicates here. That would give rise, of course, to a finer grained typology.)

A question that arises then is what the logical space of possibilities is for these aspectual profiles. Let us assume that we may classify attitude verbs in terms of whether they give rise to stative and to dynamic readings when they compose with declaratives and with questions. The profiles of the verbs that we have just mentioned may then be represented as in (64):

[17] Some regularity may be found here, of course. I am thinking of the fact that remembering and forgetting are, in a sense, mirror images of each other, or that discovering is perhaps the same as coming to know.

(64)

a.

remember	question	declarative
stative	✓	✓
dynamic	✓	✓

b.

know	question	declarative
stative	✓	✓
dynamic	NA	NA

c.

figure out	question	declarative
stative	NA	NA
dynamic	✓	✓

d.

think	question	declarative
stative	NA	✓
dynamic	✓	✓

Here, the rows can be seen as asking whether a stative or a dynamic reading is available for the clause type given in the columns, the cells say '✓' for 'available' and 'NA,' for 'not available.' Looking at the table for 'think,' for example, the NA and ✓ in the question column indicate that the predicate is necessarily dynamic with questions, and the two ✓s in the declarative column indicate that the predicate has the option of being stative or dynamic there.

This way of categorizing attitude predicates leads us to expect that there should be 16 kinds of predicate, one for every way of choosing NA or ✓ for each one of the four cells in the tables above. In practice, we will set aside the case with NAs in every cell—this corresponds to a predicate that composes neither with declaratives nor with questions. This leaves us with 15 cases to consider. We may further break these 15 possible predicates into three groups: There are three possible rogatives (NAs in the declarative column), three possible anti-rogatives (NAs in the question column), and nine possible responsives (at least one ✓ in each column).

Expecting three kinds of rogatives Now, are there robustly stative, robustly dynamic, and underspecified rogatives? Perhaps 'be curious,' 'ask' and 'investigate,' and 'wonder,' are, respectively, instances of each. The case of 'ask' and 'investigate' is, of course, not that clear given examples of the form in (65), which suggest that the predicates do pattern like statives, at least when they compose with location/repository of information nouns like 'dissertation' (Grimshaw, 2015; Anand et al., 2019; Major and Stockwell, 2021, a.o.).

(65) In her dissertation, Paloma asks/investigates whether exhaustification is constrained at all.

Expecting three kinds of anti-rogatives Similarly, are there robustly stative, robustly dynamic, and underspecified anti-rogatives? The answer to this question is slightly complicated by the possibility that there seem to be fewer and fewer anti-rogatives (in addition to difficulties pertaining to

classifying attitude predicates categorically into lexical aspectual categories).

Take the case of 'believe,' as discussed in section 5.2.2. One could argue that the predicate has a stative and a dynamic life with declaratives and only a dynamic life with questions. This would make 'believe' and 'think' similar, only that the former is robustly telic, when it is dynamic. If so, 'believe' is not anti-rogative. On the other hand, if the question embedding uses of 'believe' are treated as exceptional or if English 'believe' corresponds, in fact, to two predicates: a bona fide anti-rogative pronounced 'san-' in Turkish, and a responsive pronounced 'inan-,' our conclusions will change. I submit that 'san-,' in any case, is a good candidate for being a robustly stative anti-rogative. I will leave it at this, as what we are interested in are (in fact) possible and impossible *alternations* conditioned by clause type.

Expecting nine kinds of responsives—only four attested The predicates listed in (64) illustrate four possible aspectual profiles for responsives: The uniformly stative 'know,' the uniformly dynamic 'figure out,' the freely alternating 'remember,' and 'think.'[18] Of particular interest here are possible responsives which, like 'think,' have an asymmetric aspectual profile across declarative and question embedding. Excluding that of 'think,' there are five such profiles—all of which seem to correspond to predicates that are not attested.

Let us first consider the two profiles given in (66). The one on the left corresponds to a predicate that is necessarily stative with questions and necessarily dynamic with declaratives. The one on the right corresponds to a predicate that is necessarily dynamic with questions and necessarily stative with declaratives.

(66) a.

VERB	question	declarative
stative	✓	NA
dynamic	NA	✓

b.

VERB	question	declarative
stative	NA	✓
dynamic	✓	NA

What could such predicates mean? To be fully explicit here, we would need to know whether the predicate under consideration introduces an inquisitive or a non-inquisitive attitude in the question case, that is, whether the predicate is like 'wonder' or like 'know' when combined with a question. I will not go into detail here, referring the reader to the top of this section, and to Spector and Egré (2015), Roelofsen and Uegaki (2020) and Steinert-Threlkeld (2020) for possible constraints

[18] 'Figure out' is telic. Perhaps 'discuss' is a uniformly dynamic responsive that is atelic, to the extent that it is acceptable with 'that' clauses. Here too, its uses with inanimate subjects and with location/repository of information arguments may be stative: "In this dissertation, I discuss/this dissertation discusses whether 'think' is anti-rogative."

on the attitude a verb may introduce across declarative and question embedding. For concreteness, however, let us consider the two possibilities for the hypothetical predicate on the left, in (66a).

(67) Possible meanings for VERB (66a) across declarative and question complements

a. (i) Anna is actively considering that she should invite Brian.
   (ii) Anna knows whether she should invite Brian.

b. (i) Anna is actively considering that she should invite Brian.
   (ii) Anna wonders whether she should invite Brian.

In the dynamic declarative case, the meaning of the predicate could be paraphrased as 'actively consider that,' which is kept constant across the two pairs in (67). A stative non-inquisitive meaning in the question case may correspond to 'know whether,' giving rise to an alternation like (67a). Or, a stative inquisitive meaning may correspond to 'wonder whether,' giving rise to an alternation like (67b). To the best of my ability to discern, there is no predicate whose meaning alternates between these two pairs of paraphrases. Similar remarks apply, changing what needs to be changed, to the hypothetical predicate in (66b).

Let us finally consider the four predicates with the aspectual profiles given in (68). One of these, in (68a), is 'think,' stative or dynamic with declaratives and necessarily dynamic with questions. The hypothetical verbs in (68b) and (68c) are stative or dynamic with questions, but the former is necessarily dynamic with declaratives and the latter, necessarily stative. The last predicate in (68d) is stative or dynamic with declaratives, but necessarily stative with questions.

(68)

a.

think	question	declarative
stative	NA	✓
dynamic	✓	✓

b.

VERB	question	declarative
stative	✓	NA
dynamic	✓	✓

c.

VERB	question	declarative
stative	✓	✓
dynamic	✓	NA

d.

VERB	question	declarative
stative	✓	✓
dynamic	NA	✓

Again, I have been unable to find predicates that fit the aspectual profiles given in (68b), (68c) and (68d). For concreteness, let us illustrate what a verb like (68d) could mean:

(69) Possible meanings for VERB (68d) across declarative and question complements

a. (i) Anna thinks that she should invite Brian.
   (ii) Anna is thinking that she should invite Brian.
   (iii) Anna wonders whether she should invite Brian.

b. (i) Anna thinks that she should invite Brian.
   (ii) Anna is thinking that she should invite Brian.
   (iii) Anna has a belief about whether she should invite Brian.

Here, let us assume that the stative and the dynamic meanings of the predicate in declarative embedding can respectively be paraphrased as 'thinks that' and 'is thinking that.' This is kept constant across the triples in (69). In the question case, the verb could introduce a stative inquisitive attitude, in (69a-iii), or a stative non-inquisitive attitude, in (69b-iii). But I am unaware of such a predicate.

In sum, out of nine possible aspectual profiles for responsive predicates, only four seem to be attested—ones corresponding to 'know,' 'figure out,' 'remember' and 'think.' Descriptively, two constraints emerge that tease apart the attested predicates from the unattested ones. The first one is given in (70).

(70) Letting VERB stand in for any responsive verb, a dynamic reading for 'VERB wh-' is available iff a dynamic reading for 'VERB that' is available.

This constraint simply states that the (un)availability of a dynamic reading with questions must match the (un)availability of a dynamic reading with declaratives. We can check that the constraint rules out the predicates (66a), (66b), (68c) and (68d), as desired. These predicates all have one NA and one ✓in their dynamic row, which means that they differ in the availability of dynamic readings across declarative and question complements. The constraint rules in 'know' (with two NAs in the dynamic row) as well as 'remember,' 'figure out,' and 'think' (with two ✓s in the dynamic row). But it is too permissive, as it also leads us to expect that predicate (68b) should also be available.

In addition to (70), let us further require that the set of readings that a responsive has with questions must be a subset of the readings that it has with declaratives. We can formulate this in a general way as in (71). (The second clause, here, repeats the 'if' direction of the constraint in (70).)

(71) Letting VERB stand in for any responsive verb,

a. if a stative reading is available for 'VERB wh-,' then a stative reading is available for 'VERB that'

b. and, if a dynamic reading is available for 'VERB wh-,' then a dynamic reading is avail-

able for ‘VERB that.’

This constraint will effectively rule out the hypothetical predicate in (68b), as it has (by assumption) a stative reading with questions but not with declaratives. Going forward, we will want to see if these two restrictions on the kinds of attitude verbs that are attested hold up to further scrutiny and whether they can be simplified (so that, for example, they do not overlap). We will also want to explain them.

Chapter 6

Outlook

Setting aside accounts of the distribution of embedded clauses in terms of syntactic or semantic selection, two kinds of accounts are available in the literature. Both kinds of accounts make use of semantic properties of attitude verbs (perhaps, of attitude reports) but they do so in a different way. Let me illustrate with the kinds of generalizations that each kind of account may build on.

Egré (2008) argues, for example, that if an attitude verb embeds declaratives and is factive, then it also embeds questions. An account faithful to this generalization must explain responsivity in terms of factivity: What is it about factivity that makes factive declarative embedders question embedders?

As we have been seeing, Mayr (2019) and Theiler et al. (2019), among others, argue that if an attitude verb embeds declaratives and is neg-raising, then it does not embed questions. An account faithful to this generalization must explain anti-rogativity in terms of neg-raising: What is it about the neg-raising inference that makes neg-raising declarative embedders unable to embed questions?

What is common to both kinds of accounts is that they must commit to the view that (the relevant class of) attitude verbs may *in principle* compose both with declaratives and with questions. They diverge after this: According to the first kind of theory, a structure V+Q is bound to give rise to an ungrammatical sentence unless the effect of factivity is added. According to the second kind of theory, a structure V+Q is bound to give rise to a grammatical sentence, unless the effect of neg-raising is added. In the former, a semantic property 'saves' the sentence and in the latter, a semantic property 'dooms' the sentence.[1]

A second point that is common to both kinds of accounts is that they make use of the notion that

[1]Instead of 'saving' and 'dooming,' one could also talk about 'licensing' and 'anti-licensing' (structures containing) embedded questions. But these terms are less intuitive and more charged, theoretically.

there are anomalous meanings (tautologies and contradictions, but other kinds of constraints are imaginable) that are causes of ungrammaticality. We may now be slightly more specific: According to the first kind of theory, V+Q is bound to give rise to an anomalous meaning, according to the second kind, V+Q is not expected to give rise to an anomalous meaning—unless a semantic property of the attitude verb changes the outcome.

One additional fact about the dooming kind of theory is that it has been extended to explain not only restrictions on the distribution of embedded questions, but also restrictions on the distribution of embedded declaratives. This is the idea that 'wonder that,' for example, is ungrammatical because its meaning is contradictory (Uegaki, 2015; Theiler et al., 2019).[2]

***

The main contribution of this dissertation is that there are restrictions on the distribution and interpretation of structures containing embedded questions that are semantic-property based (as opposed to arising due to lexical selection) but that do not bear the signature of 'saving' or 'dooming' based accounts.

To compose a question with 'think,' there is no need for a semantic property to make the structure grammatical (i.e., no saving required) and there is no semantic property, among the relevant ones, that makes the structure ungrammatical (i.e., no dooming needed). Rather, composing 'think' with a question gives rise to a dynamic eventuality predicate, and to observe it, we need to insert 'think' and its question complement in structures where dynamic predicates are acceptable. We have seen a variety of (grammatical) aspect and tense combinations where this was possible. In fact, there is a strong sense in which we have seen no such combination that made 'think + Q' ungrammatical. In the present simple, for example, we have simply observed that 'think + Q' gave rise to special interpretations, harder to bring out, but ones that dynamic predicates usually receive in the present simple (e.g., the habitual or the sportscaster's present). This does not preclude the possibility that environments might exist (perhaps in languages other than English) in which dynamic predicates receive no interpretation. In such environments, we might expect to find that (the counterpart of) 'think' is ungrammatical with questions.

Generalizing this state of affairs, it appears that objects that result from composing certain verbs with clauses have particular semantic properties that make those objects picky. This is not verbs being picky about the kinds of clauses that they may combine with, but rather, 'verb + clause'

[2]There is a sense in which declaratives do not need to be saved. An example of saving declaratives would look like the following: 'schmonder that' is unacceptable (like 'wonder that' usually is) unless 'schmonder' is negated, for instance, in which case 'not schmonder that' is acceptable.

combinations being picky about the kinds of environments that they may occur in. We already know that different types of clauses may affect the interpretation of a verb: 'Tell,' for example, is non-veridical with declaratives but most naturally veridical with questions. So it is not surprising in itself to find that a composing a given verb with one type of clause results in an object with different semantic properties than if we had composed it with another type of clause. What is surprising, however, is that in the present case, these particular semantic properties affect the environments in which different types of embedded clauses are most naturally found, whereas (non-)veridicality does not have this kind of effect.

It is legitimate to ask whether it is conceptually the same or different to say that 'think + Q' is acceptable in the progressive, for example, because the structure is 'saved' there, or unacceptable in the present simple, because it is 'doomed.' I believe that the answer to this question, which I sense might be ill-posed despite being legitimate, depends on how the affinity is implemented between statives and the present simple, on the one hand, and dynamic predicates and the progressive, on the other. To the extent that we will not appeal, here, to attitude related properties like factivity or neg-raising and to the extent that we will not appeal to L-analycity either, the answer seems to be that there is a conceptual difference between the restrictions that we have seen in this dissertation and 'saving' and 'dooming' based approaches to clausal embedding.

I will end by saying that in addition to showing a third way of accounting for the distribution and interpretation of structures containing embedded questions, we have also shrunk the empirical coverage of accounts that derive the anti-rogativity of neg-raising predicates based on the excluded middle presupposition. There does, however, appear to be a link between neg-raising and anti-rogativity—only that there is a third factor involved, namely stativity. Question embedding and neg-raising exclude each other, but this is because question embedding and stativity, on the one hand, and neg-raising and dynamicity, on the other, exclude each other. I have proposed one way of understanding the link between question embedding and dynamicity. The link between neg-raising and stativity remains yet to be understood. Here too, it will be useful to explore whether the inference should rather be derived via global semantic factors that make reference to lexical aspect.

Bibliography

Abrusán, Márta. 2011. Predicting the presuppositions of soft triggers. Linguistics and Philosophy 34:491–535.

Abusch, Dorit. 2010. Presupposition triggering from alternatives. Journal of Semantics 27:37–80. URL +http://dx.doi.org/10.1093/jos/ffp009.

Aloni, Maria. 2007. Free choice, modals, and imperatives. Natural Language Semantics 15:65–94.

Anand, Pranav, Jane Grimshaw, and Valentine Hacquard. 2019. Sentence embedding predicates, factivity and subjects. In A Festschrift for Lauri Karttunen, ed. Cleo Condoravdi.

Anand, Pranav, and Valentine Hacquard. 2014. Factivity, belief and discourse. The Art and Craft of Semantics: A Festschrift for Irene Heim 1:69–90.

Arche, María J. 2006. Individuals in time. John Benjamins.

Bartsch, Renate. 1973. "Negative transportation" gibt es nicht. Linguistische Berichte 27:1–7.

Bary, Corien. 2009. Aspect in Ancient Greek: A semantic analysis of the aorist and imperfective. Doctoral Dissertation, Radboud Universiteit Nijmegen.

Bary, Corien, and Emar Maier. 2019. The landscape of speech reporting. Radboud University and University of Groningen manuscript.

Beaver, David. 2010. Have you noticed that your belly button lint color is related to the color of your clothing? In Presuppositions and discourse: Essays offered to Hans Kamp, ed. R. Bauerle, U. Reyle, and T. E. Zimmermann, 65–99. Elsevier.

Beaver, David, and Emiel Krahmer. 2001. A partial account of presupposition projection. Journal of Logic, Language and Information 10:147.

Beaver, David, and Henk Zeevat. 2007. Accommodation. In The oxford handbook of linguistic interfaces, 503–536. Oxford University Press.

Beck, Sigrid, and Hotze Rullmann. 1999. A flexible approach to exhaustivity in questions. Natural Language Semantics 7:249–298.

Bennett, Michael, and Barbara Partee. 1972. Toward the logic of tense and aspect in english. Indiana

University Linguistics Club.

van Benthem, Johan. 1989. Logical constants across varying types. Notre Dame Journal of Formal Logic 30:315–342.

Bervoets, Melanie. 2020. The Semantics of Opinion. Springer.

Bervoets, Melanie Jane. 2014. On Opining: Modal Verbs, Dispositions, Free Choice, and Negation. Doctoral Dissertation, UCLA.

Bhatt, Rajesh. 1999. Covert modality in non-finite contexts. Doctoral Dissertation, UPenn.

Bondarenko, Tanya. 2018. Factivity alternation due to semantic composition: *think* and *remember* in Barguzin Buryat. MIT Generals Paper.

Bondarenko, Tanya. 2019. From 'think' to 'remember': How CPs and NPs combine with attitudes in Buryat. In Proceedings of SALT 29.

Borik, Olga. 2002. Aspect and reference time. Doctoral Dissertation, Universiteit Utrecht.

Cable, Seth. 2020. Two Paths to Habituality: The Semantics of 'Habitual Mode' in Tlingit (and Simple Present in English). UMass Amherst manuscript.

Champollion, Lucas. 2017. Parts of a whole: Distributivity as a bridge between aspect and measurement, volume 66. Oxford University Press.

Champollion, Lucas, and Manfred Krifka. 2016. Mereology. In Cambridge hanbook of semantics, ed. Paul Dekker and Maria Aloni, chapter 13, 369–388. Cambridge University Press.

Chierchia, Gennaro, and Sally McConnell-Ginet. 1990. Meaning and grammar: An introduction to semantics.

Ciardelli, Ivano, Jeroen Groenendijk, and Floris Roelofsen. 2018. Inquisitive Semantics. Oxford University Press. URL `http://fdslive.oup.com/www.oup.com/academic/pdf/openaccess/9780198814788.pdf`.

Ciardelli, Ivano, and Floris Roelofsen. 2015. Inquisitive dynamic epistemic logic. Synthese 192:1643–1687.

Collins, Chris, and Paul M Postal. 2014. Classical NEG raising: An essay on the syntax of negation, volume 67. MIT Press.

Collins, James N. 2020. What's an excluded middle inference?: Neg-raising, projective content, and accommodation. Ms., University of Sidney.

Comrie, Bernard. 1976. Aspect: An introduction to the study of verbal aspect and related problems. Cambridge University Press.

Coppock, Elizabeth. 2018. Outlook-based semantics. Linguistics and Philosophy 41:125–164.

Dayal, Veneeta. 1996. Locality in WH quantification: Questions and relative clauses in Hindi. Dor-

drecht: Kluwer.

Dayal, Veneeta. 2016. Questions. Oxford University Press.

DeBose, Charles E. 2015. The Systematic marking of tense, modality, and aspect in African American Language. In The oxford handbook of african american language, ed. Sonja Lanehart. Oxford University Press.

Demirok, Ömer, Deniz Özyıldız, and Balkız Öztürk. 2018. Attitude sensitive complementizers in Laz. Poster presentation at North East Linguistics Society (NELS) 49.

Deo, Ashwini. 2006. Tense and aspect in indo-aryan languages: Variation and diachrony. Doctoral Dissertation, Stanford University.

Deo, Ashwini. 2009. Unifying the imperfective and the progressive: partitions as quantificational domains. Linguistics and philosophy 32:475–521.

Deo, Ashwini. to appear. Imperfectivity. In Companion to Semantics, ed. Cécile Meyer Lisa Matthewson and Hotze Rullmann. New York: Wiley Blackwell.

Dowty, David. 1979. Word meaning and Montague grammar: The semantics of verbs and times in generative semantics and in Montague's PTQ. Springer Science & Business Media.

Egré, Paul. 2008. Question-embedding and factivity. In Grazer Philosophische Studien 77, ed. F. Lihoreau, 85–125.

Elliott, Dale. 1971. The grammar of emotive and exclamatory sentences in english. Doctoral Dissertation, Ohio State University.

Elliott, Dale. 1974. Toward a grammar of exclamations. Foundations of language 11:231–246.

Elliott, Patrick. 2017a. An algebraic theory of attitudes. In Proceedings of LENLS 14.

Elliott, Patrick. 2017b. Elements of clausal embedding. Doctoral Dissertation, UCL.

Elliott, Patrick, Nathan Klinedinst, Yasutada Sudo, and Wataru Uegaki. 2017. Predicates of relevance and theories of question embedding. Journal of Semantics 34:547–554. URL `http://dx.doi.org/10.1093/jos/ffx008`.

Filip, Hana. 2012. Lexical aspect. In The Oxford Handbook of Tense and Aspect, 721–751. Oxford University Press Oxford.

von Fintel, Kai. 1999. NPI licensing, strawson entailment, and context dependency. Journal of semantics 16:97–148.

von Fintel, Kai, and Sabine Iatridou. 2008. How to say 'ought' in foreign: The composition of weak necessity modals. In Time and modality, 115–141. Springer.

Fox, Danny, and Martin Hackl. 2006. The universal density of measurement. Linguistics and Philosophy 29:537–586.

Gajewski, Jon Robert. 2002. L-analycity in natural language. MIT.

Gajewski, Jon Robert. 2005. Neg-raising: Polarity and presupposition. Doctoral Dissertation, MIT.

van Gessel, Thom, Alexandre Cremers, and Floris Roelofsen. 2018. Polarity sensitivity of question embedding: experimental evidence. In SALT 28, 217–232. LSA.

Giannakidou, Anastasia. 1998. Polarity sensitivity as (non) veridical dependency, volume 23. John Benjamins Publishing.

Giannakidou, Anastasia, and Alda Mari. 2019. Modalization and bias in questions. University of Chicago and ENS Paris manuscript.

Green, Lisa J. 2002. African American English: A linguistic introduction. Cambridge University Press.

Grimshaw, Jane. 1979. Complement Selection and the Lexicon. Linguistic Inquiry 10.

Grimshaw, Jane. 2015. The light verbs *say* and SAY. In Structures in the Mind: Essays on Language, Music, and Cognition, ed. Ida Toivonen, Piroska Csúri, and Emile van der Zee. MIT Press.

Groenendijk, Jeroen, and Martin Stokhof. 1984. Studies on the semantics of questions and the pragmatics of answers. Doctoral Dissertation, University of Amsterdam.

Hacquard, Valentine. 2006. Aspects of modality. Doctoral Dissertation, MIT.

Hamblin, Charles L. 1973. Questions in Montague English. Foundations of Language 10:41–53.

Hara, Yurie. 2018. Daroo as an entertain modal: An inquisitive approach. In Proceedings of the 25th Japanese/Korean linguistics conference.

Heim, Irene. 1988. On the projection problem for presuppositions. In West Coast Conference on Formal Linguistics (WCCFL) 2, ed. D. Flickinger et al., 114–125. Stanford University Press.

Heim, Irene. 1991. Artikel und Definitheit [Articles and Definiteness]. In Semantik: Ein Internationales Handbuch der Zeitgenoessischen Forschung, ed. Arnim von Stechow and Dieter Wunderlich. Berlin: De Gruyter.

Heim, Irene. 1992. Presupposition projection and the semantics of attitude verbs. Journal of semantics 9:183–221.

Heim, Irene. 1994. Interrogative semantics and Karttunen's semantics for *know*. In Proceedings of IATL 1, ed. Rhonna Buchalla and Anita Mitwoch.

Heim, Irene. 2000. Degree operators and scope. In Proceedings of SALT 40, ed. Brendan Jackson and Tanya Matthews. Ithaca, NY: Cornell University.

Heim, Irene, and Angelika Kratzer. 1998. Semantics in generative grammar. Blackwell Oxford.

Homer, Vincent. 2011. Polarity and modality. Doctoral Dissertation, University of California, Los Angeles.

Homer, Vincent. 2019. Actualistic Interpretations in French. Semantics and Pragmatics .

Horn, Laurence. 1978. Remarks on neg-raising. In Syntax and semantics 9: Pragmatics, ed. Peter Cole, 129–220. New York, NY: Academic Press.

Husband, Matthew. 2010. On the compositional nature of stativity. Doctoral Dissertation, Michigan State University.

Karttunen, Lauri. 1977. Syntax and semantics of questions. Linguistics and philosophy 1:3–44.

Katz, Graham. 2008. Manner modification of state verbs. In Adjectives and Adverbs: Syntax, Semantics and Discourse, ed. Louise McNally and Chris Kennedy. Cambridge: Oxford University Press.

Kenny, Anthony. 1963. Action, Emotion and Will. Routledge & Kegan Paul Limited.

Klein, E. H. 1975. Two sorts of factive predicate. Pragmatics Microfiche 1.1:B5–C14.

Klein, Wolfgang, Ping Li, and Hemriette Hendriks. 2000. Aspect and assertion in mandarin chinese. Natural Language & Linguistic Theory 18:723–770.

Kratzer, Angelika. 2004. Telicity and the meaning of objective case. In The Syntax of Time, ed. Jacqueline Guéron and Jacqueline Lecarme. MIT press.

Kratzer, Angelika. 2005. Building resultatives. Event arguments: Foundations and applications 177–212.

Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. Semantics and contextual expression 75:115.

Krifka, Manfred. 1998. The origins of telicity. In Events and grammar, 197–235. Springer.

Krifka, Manfred, Francis Jeffry Pelletier, Gregory Carlson, Alice Ter Meulen, Gennaro Chierchia, and Godehard Link. 1995. Genericity: An introduction. In The Generic Book, ed. Gregory N. Carlson and Pelletier Francis Jeffry, 1–124. Chicago University Press.

Lahiri, Utpal. 2002. Questions and answers in embedded contexts. Oxford University Press.

Lakoff, George. 1966. Stative Adjectives and Verbs in English. In Mathematical Linguistics and Automatic Translation, ed. A. G. Oettinger. Report NSF-17, The Computation Laboratory, Harvard University, Cambridge, MA, I-1-I-16.

Levin, Beth. 1993. English verb classes and alternations: A preliminary investigation. University of Chicago press.

Levin, Beth. 2009. Lexical semantics of verbs IV: Aspectual approaches to lexical semantic representation. Handout from the 2009 LSA Linguistic Institute, accessed at: `http://web.stanford.edu/~bclevin/lsa09.html`.

Lewis, David. 1979. Scorekeeping in a language game. Journal of Philosophical Logic 8:339–359.

Maienborn, Claudia. 2005. On the limits of the davidsonian approach: The case of copula sentences. Theoretical linguistics 31:275–316.

Major, Travis, and Richard Stockwell. 2021. "say"-ing without a Voice. In Proceedings of NELS 51.

Martin, Fabienne. 2019. Non-culminating accomplishments. Language and Linguistics Compass 13.

Mayr, Clemens. 2019. Triviality and interrogative embedding: Context sensitivity, factivity and neg-raising. Natural Language Semantics 27.

Moens, Marc. 1987. Tense, Aspect and Temporal Reference. Doctoral Dissertation, University of Edinburgh.

Moens, Marc, and Mark Steedman. 1988. Temporal ontology and temporal reference. Computational linguistics 14:15–28.

Močnik, Maša. 2018. Slovenian 'Dopuščati' and the Semantics of Epistemic Modals. In Proceedings of FASL 27. Michigan Slavinc Publications.

Özyıldız, Deniz. 2017a. Attitude reports with and without true belief. In SALT 27, 397–417.

Özyıldız, Deniz. 2017b. Factivity and prosody in Turkish attitude reports. UMass generals paper.

Özyıldız, Deniz. 2018. Unselected questions. Workshop on Altaic Formal Linguistics (WAFL) 14 invited talk.

Özyıldız, Deniz. 2019. Potential answer readings expected, missing. In Proceedings of Tu+ 4, ed. Yağmur Sağ and Paloma Jeretič.

Özyıldız, Deniz, Travis Major, and Emar Maier. 2018. Communicative reception reports as hear-say: Evidence from indexical shift in Turkish. In Proceedings of the West Coast Conference on Formal Linguistics (WCCFL) 37.

Paillé, Mathieu, and Bernhard Schwarz. 2018. Knowing whether and ignorance inferences. In Proceedings of WCCFL 36.

Partee, Barbara. 1986. Noun phrase interpretation and type-shifting principles. In Studies in discourse representation theory and the theory of generalized quantifiers, ed. Jeroen Groenendijk, Martin Stokhof, and Dick de Johngh, 115–143. Dordrecht: Foris Publications.

Portner, Paul. 2011. Perfect and progressive. In Semantics: An International Handbook of Natural Language Meaning (vol. 2), ed. Klaus von Heusinger Claudia Maienborn and Paul Portner, 1217–1261. Walkter de Gruyter.

Rawlins, Kyle. 2013. About 'about'. In Proceedings of SALT 23, ed. Todd Snider.

Roberts, Tom. 2018. Responsive predicates are question embedding: Evidence from Estonian. In Proceedings of Sinn und Bedeutung 22.

Roberts, Tom. 2019. I can't believe it's not lexical: Deriving distributed factivity. In Proceedings of

SALT 29.

Roberts, Tom. 2020. Argument saturation and intransitive modification: The double life of embedded clauses. NELS 51 presentation.

Roelofsen, Floris, and Wataru Uegaki. 2020. Searching for a universal constraint on the denotations of clause-embedding predicates. In Proceedings of SALT 30.

Romoli, Jacopo. 2012. Soft but strong: Neg-raising, soft triggers, and exhaustification. Doctoral Dissertation, Harvard University.

Rothstein, Susan. 2004. Structuring events: A study in the semantics of lexical aspect. Blackwell.

Sæbø, Kjell Johan. 2009. Judgment ascriptions. Linguistics and philosophy 32:327–352.

Simons, Mandy. 2007. Observations on embedding verbs, evidentiality, and presupposition. Lingua 117:1034–1056.

Spector, Benjamin, and Paul Egré. 2015. A uniform semantics for embedded interrogatives: an answer, not necessarily the answer. Synthèse 192:1729–1784.

Stalnaker, Robert. 1973/1999. Pragmatic presuppositions. In Context and content, 45–62. Oxford University Press.

Staniszewski, Frank. 2017. Partial Cyclycity and Restrictions on Neg-raising. In Proceedings of the 34th West Coast Conference on Formal Linguistics, ed. Aaron Kaplan et al., 490–497. Somerville, MA: Cascadilla Proceedings Project.

Steinert-Threlkeld, Shane. 2020. An explanation of the veridical uniformity universal. Journal of Semantics 37:129–144.

Theiler, Nadine, Floris Roelofsen, and Maria Aloni. 2019. Picky predicates: Why believe doesn't like interrogative complements, and other puzzles. Natural Language Semantics 27:95–134.

Uegaki, Wataru. 2015. Interpreting questions under attitudes. Doctoral Dissertation, MIT.

Uegaki, Wataru, and Floris Roelofsen. 2018. Do modals take propositions or sets of propositions? Evidence from Japanese 'darou'. In Semantics and Linguistic Theory, volume 28, 809–829.

Uegaki, Wataru, and Yasutada Sudo. 2019. The *hope-wh puzzle. Natural Language Semantics 27:323–356.

Vendler, Zeno. 1967. Linguistics in philosophy. Cornell University Press.

Verkuyl, Henk J. 1993. A theory of aspectuality: The interaction between temporal and atemporal structure. Cambridge University Press.

White, Aaron Steven. accepted. On Believing and Hoping Whether. Semantics and Pragmatics.

White, Aaron Steven, and Kyle Rawlins. 2018. The role of veridicality and factivity in clause selection. In Proceedings of NELS 48.

Xiang, Yimei. 2013. Neg-raising and Aspect: Evidence from Mandarin. In Pennsylvania Working Papers in Linguisitcs: Vol. 19, Iss. 1, Art. 29.

Zuber, Richard. 1982. Semantic restrictions on certain complementizers. In Proceedings of the 12th International Congress of Linguists, Tokyo, 434–436.

Zuchewicz, Karolina. 2020. On the veridicality of perfective clause-embedding verbs in polish. Doctoral Dissertation, Humboldt-Universität zu Berlin.