

UNIVERSITY OF CALIFORNIA  
Los Angeles

**Inferences of *will***

A dissertation submitted in partial satisfaction  
of the requirements for the degree  
Doctor of Philosophy in Linguistics

by

**Lauren Danae Winans**

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ABSTRACT OF THE DISSERTATION

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Cross-linguistically future tense markers can additionally be used to mark a present inference (Aikhenvald 2004). This interpretation has commonly been analyzed as an epistemic modal (Condoravdi 2002, 2003, Werner 2003, 2006, Kush 2011, Rivero 2014 a.o.). This dissertation provides an in-depth look at English *will* when it receives a present-inference interpretation. It compares this use of *will* with epistemic *must* to show that the present-inference use of future markers cannot simply be analyzed as an epistemic modal.

The dissertation puts forth two main empirical claims about how *will* differs from epistemic *must*. The first builds on the observation that epistemic modals require that the speaker have inferred the truth of the prejacent, rather than concluding it through direct perception (Karttunen 1972, von Stechow and Gillies 2010, Matthewson 2015, a.o.). Just as is observed for *must*, *will* also requires an inference, but it more constrained than *must* in the type of inferences it's compatible with. This is characterized as an incompatibility between *will* and abductive inferences. The comparison between *will* and *must* suggests that epistemic modals carry requirements about the inference they are compatible with, not the evidence. The findings for PT *will* are also replicated for the present-inference use of future tense markers cross-linguistically.

The second claim is about how epistemic modals interact with negation. Epistemic *must* is varied in how it is interpreted relative to negation. For example, it is interpreted above clause-mate negation, but below superordinate negation. In contrast, *will* is always interpreted above

negation, regardless of the syntactic configuration it occurs in. These findings are relevant for two reasons: First, *will* seems to constitute a new class of polarity sensitive predicates that is distinct from those discussed previously in the literature. Specifically, I analyze it as a “strict” Neg-Raising Predicate (NRP). This provides new insight on the semantic status of the Excluded Middle inference which has been a topic of debate for traditional NRPs (Bartsch 1973, Gajewski 2005, 2007, Romoli 2012, 2013, Kriz 2015). Second, it adds to a typology of polarity sensitive modals (Iatridou and Zeijlstra 2013, Homer 2015).

The dissertation of Lauren Danae Winans is approved.

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# CHAPTER 1

## Introduction

### 1.1 Overview

This dissertation provides an in-depth look at present-tense (PT) uses of *will*. These are cases where *will* fails to contribute any future tense meaning. This use has been described as marking a “present inference” and has been analyzed as an epistemic modal (Condoravdi 2002, 2003, Werner 2003, 2006, Kaufman 2005). I will show that despite this previous work, and despite the abundance of work on *will* in its future use, the literature is lacking a complete description of the distribution and interpretation of PT *will*. The dissertation is divided into two main parts, and it makes two main empirical observations about PT *will* and how it differs from epistemic *must*. Assuming that PT *will* is an epistemic modal, the comparison between it and epistemic *must* sheds light on how epistemic modals rely on evidence as well as how epistemic modals interact with negation.

Part I shows that PT *will* does not have the same distribution as epistemic *must* does. Chapter 2 shows that *will* is unacceptable in contexts in which the speaker infers the prejacent (embedded proposition) from its result state. For example, compare the acceptability of *will* in the smoky barbecue context (1) and the Friday night barbecue context (2):

- (1) Smoky barbecue: *Angela knows that her neighbors barbecue often. A friend is over to her house and they both smell something smoky. Angela says:*
- a. #The neighbors will be barbecuing (right now).
  - b. The neighbors must be barbecuing (right now).

- (2) Friday night barbecue: Angela and Matt know that their neighbors barbecue every Friday night. Angela and Matt are out of town, and Angela realizes it's Friday night. She says:
- a. The neighbors will be barbecuing (right now).
  - b. ?The neighbors must be barbecuing (right now).
  - c. The neighbors must be barbecuing (right now), it's Friday night.

In the smoky barbecue context, the speaker infers from the presence of smoke that the neighbors are barbecuing. This inference can be felicitously reported with *must*, but it cannot with *will*. In contrast, in the Friday night barbecue context, the speaker infers from the time of day to conclude that the neighbors are barbecuing. This inference can be reported with both *must* and *will*. I characterize this as *will* being incompatible with *abductive inferences*, whereas *must* is compatible with any inference that supports a universal claim.

Chapter 2 also shows that *will*'s incompatibility with abductive inferences is not an idiosyncratic property of English; Aikhenvald (2004) points out there are other languages that co-opt future tense markers to also encode present inference (also see Kush 2011, Mihoc 2012, Rivero 2014, Rivero and Simeonova 2014, Giannakidou and Mari 2014). I survey a number of unrelated languages to show that this evidential strategy is in fact quite common. I also show that languages that employ this evidential strategy all pattern with *will* in being incompatible with inferences from results to causes (abductive inferences).

Chapter 3 provides additional support for the claims in Chapter 2. It discusses what I call the Anaphoric Construction (AC), exemplified in (3). Notice that while the use of *will* is acceptable with the AC sentence in (3), it is unacceptable with its Non-Anaphoric (NA) counterpart in (1).

- (3) *Smoky barbecue context (same as (1))*
- a. That will be the neighbors barbecuing.
  - b. That must be the neighbors barbecuing.



I argue that unlike the inference involved in reaching the proposition denoted by the NA counterpart, the inference involved in concluding the proposition denoted by the AC sentences in (3) is not an inference from a result state to its cause (the inference is not abductive). Again, if we look at other languages that employ this evidential strategy, all show this same contrast between the AC sentences and their NA counterpart, if they allow the Anaphoric Construction.

Given the cross-linguistic prevalence of future tense markers requiring non-abductive inferences on their present-tense interpretation, we might wonder what the connection is between the future and non-abductive inferences. I argue that the connection is that claims about the future necessarily rely on non-abductive inferences. Any claim about the future must rely on inference because the future cannot be directly perceived (yet). Moreover, if an event holds in the future, its result state does not yet hold in the present. An inference about a future eventuality is not based on the presence or observation of its result state because the result necessarily doesn't exist yet. Thus, the present inference use of future tense markers is incompatible with exactly the type of inferences that are unavailable for claims about future eventualities.

Chapter 4 discusses how the incompatibility of PT *will* with abductive inferences should be analyzed. It first shows that analyses which attempt to derive this restriction from the temporal properties of the future fail. Additionally, it shows that previous approaches to how epistemic modals encode evidential restrictions (Izvorski 1997, Matthewson, Davis, and Rullmann 2007, von Stechow and Gillies 2010, Matthewson 2015) cannot straight-forwardly be extended to account for the restriction on *will*. This is because these approaches have been designed to encode restrictions on *evidence*, and the restriction on *will* is fundamentally about the *inference* (the relation that holds between the evidence and the prejacent).

Part II focuses on how PT *will* interacts with negation. Chapter 5 shows that, if we assume that PT *will* is a universal modal, it is never interpreted within the scope of negation. This constitutes another difference between PT *will* and epistemic *must*. At first glance, these modals seem to behave uniformly with respect to negation. Both necessarily scope above clause-mate negation, as in (4).

- (4) a. The neighbors must not be barbecuing (right now).  
 (i) ✓ MUST > NEG  
 (ii) ✗NEG > MUST
- b. The neighbors won't be barbecuing (right now).  
 (i) ✓WILL > NEG  
 (ii) ✗NEG > WILL

The modals do, however, differ in how they are interpreted under Neg-Raising Predicates (NRPs), such as *think* with a negation in the higher clause. This is shown in (5).

- (5) a. No one thinks John must be home.  
 (i) ✓THINK > NEG > MUST  
 (ii) ✗THINK > MUST > NEG
- b. No one thinks John will be home.  
 (i) ✗THINK > NEG > WILL  
 (ii) ✓THINK > WILL > NEG

Chapter 5 uses Homer's (2015) tests for Positive Polarity Items (PPIs) to show that both *will* and epistemic *must* do not behave like PPIs. Instead, I argue that *will* is an NRP.

Chapter 6 shows that *will* behaves like traditional NRPs with respect to cyclicity and licensing of Strict Negative Polarity Items (NPIs). While *will* does behave like traditional NRPs in some respects, I call it a "strict" NRP because it does not show the optionality in its Neg-Raising reading as traditional NRPs do. For example, the Neg-Raising reading of *think* in (6) can be explicitly canceled with a continuation, but this is not the case for *will*.

- (6) a. John doesn't think Mary is home...  
 (i) ...because he doesn't have an opinion either way.
- b. John won't be home right now,  
 (i) ...#because I don't have an opinion either way.  
 (ii) ...#he might not be.

In addition, the inference associated with the Neg-Raising property clearly passes projection tests with *will*, but it doesn't with *think*. For this reason, I propose that the presuppositional analysis of Gajewski (2005) be extended to PT *will*.

Chapter 6 also shows that the negation facts observed for PT *will* hold for future uses of *will* as well. Consider the interpretations of the sentences in (7).

- (7)
- a. Gina won't make dinner tonight, #but she might.
  - b. Londen won't be home tomorrow.
  - c. Cassy won't attend school tomorrow.

Again, assuming that *will* is a universal modal, all of these sentences are interpreted with *will* scoping over negation. For example, (7a) does not have a reading where it is not necessarily the case that Gina cooks dinner tomorrow night (NEG > WILL). If this reading were available, we would expect it to be felicitous to continue with *she might*.

Chapter 7 concludes and discusses future directions. It briefly discusses the empirical observations for Part I and Part II of the dissertation and shows that these empirical observations extend to all uses of *will*. It also suggests how these two properties might be related.

## 1.2 Background on epistemic modality and evidentiality

This section discusses modals, such as those in (8), and provides background on a Kratzerian semantics for modals Kratzer (1977, 1991, 2012).

- (8)
- a. John might be home.
  - b. John must be home.

Unlike their unmodalized counterpart (i.e., *John is home*), the sentences in (8) make claims about what is possible or necessary rather than what is. I will refer to the proposition embedded under the modal as the *prejacent*. The context, as well as other factors, determine what

the prejacent is possible or necessary relative to. For example, if John’s mother requires him to be home on Sunday, I could say: *Given mom’s rules, John must be home on Sunday*. This is a deontic reading of *must*. If instead, John’s lights are on and he always turns them off when he leaves, I could say: *Given that his light is on, John must be home right now*. This is an epistemic reading of *must*.

Rather than proposing that all modals are systemically ambiguous, Kratzer argues that each have an underspecified meaning and that the different readings come from contextually determined “conversational backgrounds.” These conversational backgrounds are sets of propositions, as defined in (9).

(9) CONVERSATIONAL BACKGROUNDS

- a. Epistemic:  $f(w)$  is a set of facts known in  $w$ .
- b. Deontic:  $f(w)$  is a set of rules in force in  $w$ .
- c. Bouletic:  $f(w)$  is a set of desires in  $w$ .
- d. Stereotypical:  $f(w)$  is a set of expectations concerning what  $w$  is like.
- e. ....

The conversational background determines a set of worlds—all those compatible with the propositions in the conversational background,  $\bigcap f(w)$ . The modal asserts that all or some of the worlds are ones where the prejacent holds. AN example of necessity and possibility modals are given below.<sup>1</sup>

(10) TEMPLATE FOR MODAL MEANING

- a.  $\llbracket \text{must} \rrbracket^{w,f} = \lambda p_{\langle s,t \rangle} . \forall w' [w' \in \bigcap f(w) \rightarrow p(w') = 1]$
- b.  $\llbracket \text{might} \rrbracket^{w,f} = \lambda p_{\langle s,t \rangle} . \exists w' [w' \in \bigcap f(w) \wedge p(w') = 1]$

---

<sup>1</sup>For simplicity, I ignore the role of an ordering source.

Modals aren't completely underspecified though. Not all modals can occur with all types of conversational backgrounds. Instead, modals are lexically specified for which ones they are compatible with, as in (11).

- (11) PRESUPPOSITIONS ON MODAL BASES Portner (2009)
- a.  $\llbracket \text{must} \rrbracket^{w,f}$  is only defined if  $f$  is an epistemic or deontic conversational background.

The content of the conversational background can be explicitly specified with an *in view of...* or *given that...* clause, as in (12).

- (12) EXPLICITLY DETERMINING THE CONVERSATIONAL BACKGROUND
- a. In view of/given Mom's rules, we must clean our rooms.
  - b. In view of the news report, John must be the murderer.
  - c. Given that the news said John was in Bolivia that day, he must be the murderer.
  - d. Given that you want to arrive on time, you shouldn't take the 405.

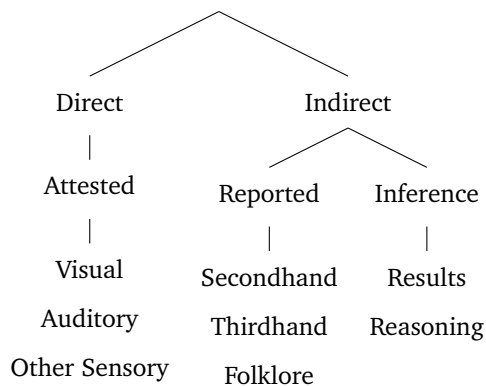
(12a) states that all of the worlds compatible with Mom's rules are ones in which we clean our rooms. The focus of this dissertation is epistemic modals, as in (12b). With an epistemic conversational background, an assertion with *must* claims that the prejacent is true in all worlds compatible with some set of facts or knowledge. Recently, epistemic modals have been claimed to depend on worlds compatible with *evidence* rather than *knowledge* (von Stechow and Gillies 2010, Kratzer 2012, Matthewson 2015). These analyses will be discussed in-depth in Chapter 4.

Evidentiality is a phenomenon related to, but potentially independent from, epistemic modality. Evidentiality is the encoding of a speaker's source of evidence for a proposition. Below are examples from Cuzco Quechua in which the propositional content is uniform across the examples but the evidential component varies (Faller 2002, Faller 2006).

- (13) Para-sha-n-mi  
rain-PROG-3-mi  
 $p$ ='It is raining'  
EV=speaker sees that  $p$
- (14) Para-sha-n-si  
rain-PROG-3-si  
 $p$ ='It is raining'  
EV=speaker was told that  $p$
- (15) Para-sha-n-chá  
rain-PROG-3-chá  
 $p$ ='It is raining'  
EV=speaker conjectures that  $p$

Willett's (1988) typology of evidential markers is given in (16) below. These categories classify the type of evidence a speaker has for a given proposition.

- (16) TYPES OF SOURCES OF INFORMATION (Willett 1988)



There have been claims that epistemic modals and evidentials are completely distinct categories (Aikhenvald 2004, De Haan 1999), while others have claimed that they completely overlap (Matthewson 2015). This dissertation focuses on how epistemic modals encode information about evidence. Karttunen (1972) noticed that *must* requires that the speaker have inferred the truth of the embedded proposition; one cannot have direct evidence for the propo-

sition. One of the goals of this dissertation is to explore further how epistemic modals encode information about evidence.

Evidential markers have also been analyzed as epistemic modals, starting with Izvorski's (1997) work on the Perfect of Evidentiality (PE) in Turkish, Bulgarian, and Norwegian. Informally, Izvorski (1997) gives the following interpretation to PE evidentials in (17).<sup>2</sup>

- (17) INTERPRETATION OF  $EV_p$ :
- a. Assertion:  $\Box p$  in view of the speaker's knowledge state
  - b. Presupposition: *Speaker has indirect evidence for p*

Under the informal definition in (17), the evidential perfect asserts that the speaker's epistemic state supports the prejacent. The presupposition specifies the speaker's grounds for coming to know  $p$ . Izvorski's (1997) proposal (as well as others, e.g., Matthewson et al. 2007) formally analyzes the evidential component as a restriction of the set of propositions in  $f(w)$  to just those compatible with a particular type of evidence:

- (18) a.  $f(w) = \{p: \text{speaker considers } p \text{ indirect evidence in } w \}$   
 b.  $\bigcap f(w) = \{u \in W: \forall p[(p \text{ is the indirect evidence in } w) \rightarrow u \in p]\}$   
 (Izvorski 1997 p. 230)

Under this type of analysis a 'typical' epistemic modal quantifies over all of the speaker's knowledge, but an evidential epistemic modal only quantifies over a subset of that knowledge. The problem with this view is that there is little empirical evidence that these 'typical' epistemic modals exist. Even English *must*, the most widely discussed epistemic modal in the literature, has been argued to carry information about evidence (Stone 1994, von Stechow and Gillies 2010, Matthewson 2015).

Kratzer (2012) advocates for a new view of epistemic modality which is evidence-based rather than knowledge based. She writes:

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<sup>2</sup>Again, I ignore the contribution of the ordering source for simplicity.

Cross-linguistically, the invariant job of an evidential is to classify evidence for what is being said as direct, indirect, or hearsay...**The cross-linguistically invariant job of an epistemic modal is not to classify evidence, but to assess the truth of a proposition against a range of possibilities projected from a body of evidence.** There are two distinct semantic jobs to be done, then: classify evidence versus assess the truth of a proposition against possibilities projected from a body of evidence. (p. 23, emphasis added)

Rather than defining the epistemic modal base as being the set of worlds compatible with the speaker's knowledge, it is limited to worlds compatible with a particular type of evidence the speaker has. There is still an open question as to what the connection between epistemic modality and evidentiality is. For example, von Stechow and Gillies (2010) claim that all epistemic modals carry the same evidential requirement—they are incompatible with direct evidence—whereas Matthewson (2015) claims that epistemic modals vary in their evidential component. The data presented in Part I of this dissertation adds to this debate by comparing epistemic *must* to PT *will*, which is often analyzed as an epistemic modal.



Part I

# Epistemics and Inferences

## CHAPTER 2

### Inferential restriction of *will*

Aikhenvald (2004) lists future tense markers as a category that often undergoes an evidential extension. She writes: “Future indicative forms develop extensions to do with inference and speculation. This extension arises out of overtones of uncertainty and prediction associated with future” (page 109). She cites Afghan Persian, Andean Spanish, and Abkhaz as examples of languages that employ this evidential strategy. English is also a language that employs this strategy, using *will* to mark an inference. Section 2.1 briefly describes this use of *will*, and Section 2.2 provides background on previous analyses by Condoravdi (2002, 2003) and Werner (2003, 2006). Section 2.3 shows that *will* cannot be used to mark all types of inferences; it is incompatible with an inference from a result to a cause. I characterize this as an incompatibility with abductive reasoning. Section 2.6 discusses additional languages that employ this evidential strategy. In these languages, the co-opted future markers show the same incompatibility with abductive reasoning that *will* does.

#### 2.1 Description of inferential use of *will*

Distinguishing so-called predictive uses of *will* from inferential uses is extremely difficult. This is because all claims about the future rely on some inference; one cannot directly perceive future eventualities (yet). It is much easier to distinguish between future and present-tense uses of *will*. The ‘present-tense’ (PT) categorization refers to the temporal interpretation of the prejacent (“inner tense” in Condoravdi’s (2002) terminology). For example, in the sentence *Becky will be home right now*, the prejacent, that Becky is home, is interpreted as holding at the utterance time. This is a clear case of ‘inferential *will*’ because there is no future meaning.

Note that this sentence does not have to come with a ‘check-and-see’ or future evaluation time reading. In a context where I’m debating going home to let out the dog, Greg can say *Becky will be home right now, so don’t worry about the dog*. His utterance conveys that we don’t need to go check and see if someone is home.

For the majority of the dissertation, I will focus on these clear cases of PT *will*. In Chapter 7, I will return to future *will* and show that all of the empirical generalizations for PT *will* also hold for future *will*. I focus on the present-tense uses because the fact that future claims are necessarily based on inference obscures the data.

One common use of PT *will* is in contexts where the speaker has inferred the truth of the prejacent based on a schedule. For example, in a context in which the speaker knows that Lindsay always works at 7pm and that it is currently 7pm, (19) is acceptable.

(19) Lindsay will be at work (right now).

Additionally, the use of (19) is acceptable if the inference is based on a plan (rather than a schedule). For example, in a context in which the speaker knows that Lindsay usually works during the day, but tonight has planned to work a night shift, (19) is also appropriate. In the contexts described above, the speaker is reasoning based on (i) a plan or schedule and (ii) the current time (and possibly Lindsay’s general habits of keeping her schedule and/or plans).

PT *will* can also be used in contexts in which there is no explicit plan or schedule, but the speaker instead infers the prejacent based on predictable behavior. For example, (20) is acceptable in a context in which the speaker knows that Lane is generally scared of loud sounds, and she sees on the weather report that there are thunderstorms in the town Lane lives in.

(20) Lane will be scared (right now).

(20) is acceptable even if Lane has never heard thunder before. This shows that *will* does not require a plan or a schedule. In fact, PT *will* does not even require that the speaker’s inference

be about the behavior of an agent. For example, (21) can be uttered in a context in which the speaker has left enough cat food for her three-day trip but has decided to stay out of town an extra day.

(21) The cat will be running out of food (by now).

In inferring the truth of the prejacent, the speaker is reasoning about how much food was left and how much food she thinks the cat needs daily.

The interpretation of a sentence with PT *will* is similar to those with epistemic *must*. The sentences above, (19)-(21), are similar to those in (22), and are acceptable in the contexts discussed above.

- (22)
- a. Lindsay must be at work (right now).
  - b. Lane must be scared (right now).
  - c. The cat must be running out of food (by now).

Although the meaning of PT *will* and *must* are similar, they do however differ from each other. This chapter will discuss one way in which they differ; but first, I will discuss previous analyses of PT *will*.

## 2.2 Previous analyses of *will*

There is a long-standing debate as to whether *will* is purely a future tense marker (Kamp and Ryle 1993, Heim 1994, Abusch 1997, Kissine 2008, a.o.) or if it additionally encodes quantification over possible worlds (Prior 1967, Enç 1996, Condoravdi 2002, Werner 2006, Kaufman 2005, a.o.). This debate has revolved around future interpretations of *will*. As discussed above, the present-tense interpretation of *will* contributes no future meaning, making a solely temporal semantics of the modal untenable. For arguments as to why future interpretations of *will* are modal, see Klecha (2014).

The present-tense (PT) use of *will* has been analyzed as an epistemic modal (Condoravdi 2002, 2003, Werner 2003, 2006). These authors notice that there is a correlation between the temporal interpretation of the eventuality of the prejacent and its flavor of modality. In particular, the temporal properties are determined by the eventivity of the prejacent: if the predicate is stative, the tense can be present or future; if the predicate is eventive, the tense can only be future.

(23) EVENTIVITY AND TEMPORAL INTERPRETATION (WITH MODALS)

- a. John {must/will} be home {right now/ tomorrow/ #last week}.                      Stative
- b. John will go home {#right now/ tomorrow/ #last week}.                              Eventive

There is an interpretation of (23b) that is compatible with the adverb *right now*. It is one in which John is about to start going home right after the sentence is uttered. This is a future interpretation. (23b) cannot have a present interpretation in which John is currently walking home. To achieve this means the predicate would need to be made stative (*be walking home*). I will continue to use *right now* to diagnose present-tense interpretations of *will*, but it is important to keep this interpretation of *right now* in mind. Possibly, a better diagnostic is whether the truth conditions of the sentence require that the eventuality hold at the utterance time.<sup>1</sup> For example, if at 3:00 I say *John will be home right now*, and we find out later that John got home at 3:30 or 4:00, I was wrong; my claim was false. (23a) is false if John's being home starts after the utterance time. (It is not future.) In contrast, if I am with John and his mom calls, and it's past his curfew, I can say *John will go home right now*. During the utterance time, John is standing next to me (not going home), but after I hang up he starts going home. This is still a future interpretation. (23b) is true if his going home starts after the utterance time. (It is future.)

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<sup>1</sup>Thanks to Roger Schwarzschild for suggesting this to me.

Condoravdi (2002) derives these facts from how these predicates are interpreted in non-modal environments. Notice that the pattern from (23) is completely parallel to the non-modalized versions in (24).

- (24) EVENTIVITY AND TEMPORAL INTERPRETATION (WITHOUT MODALS)
- a. John is home {right now/ tomorrow/ #last week}. Stative
- b. John runs {#right now/ tomorrow/ #last week}. Eventive

For this reason, Condoravdi encodes the temporal facts in a general “AT” operator that determines how eventualities are temporally interpreted. This operator will be discussed below.

Following Abusch (1988, 1997, 1998), it is fairly standard to analyze *will* as the present tense form and *would* as the past tense form of a single modal *woll*. Condoravdi’s (2002) definition for *woll* is given below. Notice that this denotation is not particularly unique to *woll* but is instead the standard denotation for all universal modals (setting aside the role of ordering sources). In Condoravdi’s system, all modals combine with sentence radicals, which are predicates of eventualities. All modals are analyzed as introducing a time interval that spans forward into the future (represented as  $[t, \_)$ ). And, for all modals, where the eventuality holds in that time interval (present or future) depends on the eventivity of the predicate. She accounts for the dependence on the predicates eventivity through an independent “AT” operator. This is shown below in (25) and (26).

$$(25) \quad \text{WOLL}_{MB} = \lambda P \lambda w \lambda t \forall w' [w' \in MB(w, t) \rightarrow AT([t, \_), w', P)] \quad \text{Condoravdi (2002)}$$

$$(26) \quad AT(t, w, P) = \begin{cases} \exists e [P(w)(e) \& \tau(e, w) \subseteq t] & \text{if } P \text{ is eventive} \\ \exists e [P(w)(e) \& \tau(e, w) \circ t] & \text{if } P \text{ is stative} \\ P(w)(t) & \text{if } P \text{ is temporal} \end{cases}$$

If  $P$  is a sentence radical, a property of eventualities, then the AT operator binds its event argument. If  $P$  is eventive, then the AT operator says the temporal trace of the eventuality ( $\tau(e, w)$ ) is contained in the temporal interval that AT takes as an argument. For example, in

an (unembedded) modal sentence, the time argument is [*now*,<sub>-</sub>), an interval that starts at the speech time and continues into the future. Thus, if the predicate is eventive, the temporal trace of the eventuality is within the interval that starts at now. In contrast, if *P* is stative, then the temporal trace of its eventuality ( $\tau(e, w)$ ) overlaps with the temporal interval that AT takes as an argument. Overlap, rather than containment, allows the eventuality to be interpreted as holding at the time of the utterance. Finally, if *P* is not a sentence radical—if its event argument has already been bound—AT simply feeds the time and world argument to *P* without altering the temporal relations.

The flavor of the modal also correlates with the temporal interpretation of the modal. Werner (2006) claims that across modals there is an alternation between present epistemic interpretations and future root interpretations. This is shown in (27).<sup>2</sup>

- |      |                         |                   |
|------|-------------------------|-------------------|
| (27) | a. John must leave.     | future/deontic    |
|      | b. John must have left. | present/epistemic |

In Werner’s analysis, the temporal interpretation of the prejacent is derived from the flavor of the modal. In Condoravdi’s analysis, the flavor of the modal is derived from the temporal interpretation of the prejacent. Both analyses rely on similar principles that constrain the interpretation of a modal via the structure of the modal base. In what follows, I will focus on Condoravdi’s (2002) analysis, but the interested reader is referred to Werner (2006) for a comparison of the two analyses.

For *must*, it is clear that the alternation is between deontic and epistemic conversational backgrounds, as in (27). The situation is less clear with *will*. There have been many different proposals for which conversational backgrounds *will* is compatible with; these are summarized in Figure 2.1.

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<sup>2</sup>Werner (2006) among others have claimed that there is no future epistemic interpretation of *must*. There do seem to be examples that contradict this, as in (i). These examples tend to involve a plan or schedule.

- (i) John must leave tomorrow, the train only leaves once a month and it is tomorrow.

Figure 2.1: Modal flavors of *will*

	Present interpretation	Future interpretation
Condoravdi (2002)	epistemic	epistemic/metaphysical
Werner (2006)	epistemic	totally realistic
Kaufman (2005)	subjective epistemic/ doxastic	objective epistemic
Abusch (2012)		circumstantial
Giannakidou and Mari (2014)	epistemic	epistemic

The variation occurs mostly in the flavors attributed to the future interpretations of *will*.<sup>3</sup> I will not discuss the differences between the different proposals. The discussion will focus on the present interpretation, for which there is no disagreement.

In Condoravdi’s (2002) analysis, the modal base for *will* can be either epistemic or metaphysical. An epistemic modal base contains worlds compatible with what the speaker knows (but see discussion of evidence-based epistemic modality in Chapter 4). A metaphysical modal base contains all the worlds that are “historical necessities”: the worlds that share all the same facts with the actual world up until “now.”

Recall that the temporal interpretation (and by extension the eventivity of the predicate) correlates with the possible interpretations (modal bases). When the eventuality is interpreted with present time reference, it receives an epistemic interpretation. When the eventuality is interpreted with future time reference, the modal can have either an epistemic or a metaphysical interpretation.

(28) STATIVE AND MODAL FLAVOR INTERPRETATIONS

- a. John will be home right now. =only epistemic
- b. John will be home tomorrow. =epistemic/metaphysical

(29) EVENTIVE AND MODAL FLAVOR INTERPRETATIONS

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<sup>3</sup>Some of this variation might also just be variation in terminology.



- a. #John will run the race right now.
- b. John will run the race tomorrow. =epistemic/metaphysical

In Condoravdi’s (2002) analysis, the metaphysical reading is only available with future time reference, but the epistemic reading is available for both present and future interpretations. The present metaphysical reading is ruled out by general principles about the structure of modal bases (for Condoravdi 2002 the *Diversity Condition*, and for Werner 2006 the *Disparity Principle*). The focus of the dissertation is on the cases with present time reference—when *will* unambiguously has an epistemic interpretation. I will, however, discuss the connection with the future/metaphysical interpretation in Chapter 7.

I will refer to analyses in which *will* is an epistemic modal on its present interpretation as “epistemic-only” accounts of present-tense *will*. (See again Figure 2.1.) In this type of account, present-tense *will* has a semantics very similar to *must*; both are universal epistemic modals, although the modal domain for *must* may additionally be determined by an ordering source.

As a first observation, *will* and *must* do share a basic evidential requirement: just as Karttunen (1972) shows for *must*, PT *will* is incompatible with direct evidence. This is shown in (30).

- (30) *Seeing rain pouring from the sky*
- a. #It must be raining.
  - b. #It will be raining.

This is the first empirical fact we have observed for PT *will*. If PT *will* is an epistemic modal, this fact is unsurprising given the claim by von Stechow and Gillies (2010) that *all* epistemic modals are incompatible with direct evidence.

- (31) Empirical generalizations for PT *will*: (to be revised)
- will-p* can be uttered iff:
  - speaker does not have direct evidence for *p*

The data in this Chapter and the next add to the empirical generalizations for *will* and show that an epistemic-only account is insufficient to account for the distribution and interpretation of present-tense *will*. I will present the behavior of epistemic *must* as a baseline for epistemic modals and compare PT *will* to it.

### 2.2.1 Anaphoric requirement of epistemic modals

This section gives an overview of Stone's (1994) observation that *must* is discourse-anaphoric and shows that this is not a property it seems to share with *will*. The goal of this section is not to evaluate the analysis provided by Stone but to instead introduce one property of *must* that can be used as a comparison for *will*. When the behavior of *must* and *will* are compared in the rest of this chapter and the next, it is important to keep the difference in anaphoricity in mind so it doesn't obscure other differences or similarities between the modals.

Stone (1994) notices that out-of-the-blue contexts, such as in (32), give rise to certain implicatures or accommodation patterns.

(32) Ann asked "Where is the sugar?" and Mary answered, "It must be in the cabinet over the fridge." = (12); Stone

Stone observes that when (32) is presented without more contextual support, two types of inferences arise: (i) an outside reader can infer certain properties about the larger context, and (ii) the addressee, Ann, can infer certain properties about Mary's inference. Here, I will focus on the second inference: the addressee's assumptions about how Mary concluded the prejacent. Given Mary's use of *must*, Ann naturally takes Mary to have concluded the location of the sugar based on information in the context: for example, she saw a trail of sugar leading to that cabinet, or she has looked everywhere besides that cabinet.

This can be compared with Mary's response had it contained *will* rather than *must*, as in (33).<sup>4</sup>

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<sup>4</sup>Stone (1994) provides a comparison with *should* which patterns with *will* with respect to this property.

(33) Ann asked “Where is the sugar?” and Mary answered, “It will be in the cabinet over the fridge.”

In (33), Ann would instead conclude that Mary knows where the sugar is generally kept; Maybe they are baking in Mary’s kitchen, or Maybe Mary knows John used the sugar last and that is where he puts it. Crucially, there isn’t something salient in the context that leads Mary to believe the sugar is over the fridge.

Stone (1994) captures this asymmetry by claiming that *must* is anaphoric to a contextually salient set of propositions that support the prejacent. A modified version of his analysis is given in (34).

(34)  $[[\text{must } p]]^{c,g} =$  there are a set of propositions  $\kappa$  salient in the common ground that justify  $p$  in  $c$ .

In applying the definition in (34) to the example in (32), the set of proposition(s) might be *if there is white particles leading to a cabinet, the sugar is in that cabinet*. This proposition would justify the proposition *the sugar is in the cabinet over the fridge* in a context in which there are white particles leading to the cabinet above the fridge.

Let’s consider a parallel phenomenon of lexical items with a discourse-anaphoric component: personal pronouns. Partee (1973) gives the example of a man walking into a bar crying and saying (14’).

(14’) She left me.

In this context, the bartender can recover that *she* must refer to the man’s female companion. This is similar to the sugar case, where Ann can infer what Mary’s evidence is. In contrast, if a man walks into a room and says *she won*, it is less easy to recover who *she* refers to. If we replaced the conversation in (32) with a more opaque inference—for example, if Mary responded “John must have eaten it all”—the use of *must* is significantly degraded or at least

leads the addressee to ask how the speaker had inferred that. In the same way, the use of *she won* is either odd or leads the addressee to ask who *she* refers to.

I will remain agnostic about how the discourse-anaphoric requirement of *must* should be derived—or even if it should—but it seems that there is evidence *will* at least does not carry the same requirement. In fact, there is weak evidence that *will* is infelicitous if the evidence is contextually shared or salient. That is, *will* may be anti-anaphoric. Compare the use of *will* and *must* in (35) and (36) below:

- (35) *Terra and Jerry live in Palm Springs. When it is forecasted to rain, Jerry spends hours putting covers on all the outdoor furniture. You and I both know this. We see on the news that it is forecasted to rain in Palm Springs soon. I say:*
- a. Jerry must be busy putting the covers on the patio furniture.
  - b. #Jerry will be busy putting the covers on the patio furniture.

In (35), the fact that there is a storm in Palm Springs is contextually salient. The use of *must* is appropriate, but the use of *will* is not.<sup>5</sup>

When the context is shifted so the storm and the habit of covering furniture is not contextually salient, the acceptability flips. As Stone (1994) predicts, the use of *must* is unacceptable. If the speaker does say this, there would be some back and forth about why she has concluded that, essentially making the evidence salient. The use of *will*, however, is acceptable.

- (36) *Terra and Jerry live in Palm Springs. When it is forecasted to rain, Jerry spends hours putting covers on all the outdoor furniture. Only I know this. I see on the news that it is forecast to rain soon in Palm Springs. You say, "I wonder if Jerry is busy, I should call him." I say:*
- a. #He must be busy putting the covers on the patio furniture.
  - b. He will be busy putting the covers on the patio furniture.

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<sup>5</sup>I should note that not all English speakers agree on this point. This is in stark contrast with other judgments about *will*. The rest of the judgments reported are widely agreed upon, but the judgment in (35b) is variable.

From (35) and (36), we might conclude that *will* has the opposite requirement as *must*, i.e., that it is anti-anaphoric. This conclusion may be premature, especially considering that the judgements are not stable across speakers for (35a). I leave the precise description and analysis of these anaphoric properties for future work. In presenting data with *will* and *must* in the rest of the dissertation, I will try to be mindful of this possible confound.

Stone (1994) analyzes *must* as being anaphoric to an argument or set of propositions salient in the common ground. Not only does *must* require that the speaker have inferred the prejacent as discussed in Chapter 1, it also requires that the set of propositions that the speaker uses in the inference be “contextually salient.” It isn’t clear how exactly we should define contextual salience, and defining this notion is outside the scope of the dissertation. Certainly, individuals or propositions that have been mentioned linguistically are salient, but other things can become salient just by virtue of being present.

We can compare the anaphoric behavior of *must* with that of personal pronouns. Par-tee (1973) claims that personal pronouns are anaphoric on a contextually salient individual. Generally, when there isn’t an individual that is salient in the context they are infelicitous. Sometimes, the use of a pronoun is felicitous without a salient individual. If the speaker can recover who the pronoun refers to, then the pronoun is felicitous. In this case, the addressee *accommodates* the referent of the pronoun, in the same way an addressee can accommodate the propositional anaphor of *must*.

### **2.3 Reasoning from result states: PT *will* vs. *must***

In this section, I discuss one way that present-tense (PT) *will* and epistemic *must* differ. This data is the first argument against the epistemic-only analysis for PT *will*. It is well known that *must* requires indirect evidence (whether epistemic: Karttunen 1972, von Stechow and Gillies 2010, Matthewson 2015, or deontic: Rett to appear). Stone (1994) writes:

...[S]peakers choose to use epistemic *must* when it serves their communicative intentions to make the dependence of claims on evidence particularly clear, not when their claims depend on evidence in a special way. (p. 3)

I adopt this view that *must*, and epistemic modals in general, invoke a body of evidence (See Chapter 4). In this section, however, I argue that *must* and *will* are compatible with the same types of evidence but differ in how information can be inferred from that evidence. Corroborating Stone's quote above, these modals differ in how the speaker's claim can depend on evidence, but they do not differ in the evidence for that claim. I show that *must* is compatible with a variety of inference types, as long as they support a universal claim. In contrast, *will* is more restricted and incompatible with a particular class of inferences.

In discussing this data, it is important to distinguish between different aspects of an inference. The contexts in which *will* and *must* occur all contain a few features: a trigger, a rule, and a conclusion, as defined in (37). There may be *must* and *will* contexts that don't contain triggers, but as von Stechow and Gillies (2010) claim, *must* always requires the speaker to "put together" at least two propositions to reach the conclusion. The trigger and rule together comprise what is in the *kernel* in von Stechow and Gillies (2010) and constitute the *argument* in Stone (1994).

(37) ANATOMY OF CONTEXTS:

- a. **trigger:** an observation, often a perception
- b. **rule:** background knowledge, often conditional but not necessarily
- c. **conclusion:** proposition denoted by the prejacent

Examples of each of these for a context is given below in (38).

(38) EXAMPLE CONTEXTS WITH INFERENCES:

- a. Smoky barbecue context
  - (i) trigger: *it's smoky out*
  - (ii) rule: *the neighbors' barbecuing causes smoke, nothing else causes smoke*

- (iii) conclusion: *the neighbors are barbecuing*
- b. Friday night barbecue context
  - (i) trigger: *it's Friday night*
  - (ii) rule: *the neighbors always barbecue on Friday nights*
  - (iii) conclusion: *the neighbors are barbecuing*

The rule connects the trigger and the conclusion. I will use the term “inference” to mean the reasoning step from the trigger to the conclusion. This is essentially using the rule to reach the conclusion from the trigger.

In this section, I use these contexts to explore the distribution of PT *will* and epistemic *must* in two ways. First, I present data in a way typical of discussing evidentials: varying the evidence (the trigger) to test the acceptability of each modal. Second, I present data that is less conventional for testing markers of evidentiality: I vary the conclusion from a single trigger, essentially varying the inference (i.e., the connection between trigger and conclusion).

Section 2.4 provides a background on inference types. This section introduces new terminology and develops independent linguistic tests for certain inferences. Section 2.6 corroborates Aikhenvald’s (2004) observation that future tense markers are frequently co-opted for present inference. It also shows that in typologically diverse languages these co-opted present inference markers are incompatible with the same class of inferences that *will* is incompatible with.

The goal of this chapter is to provide an informal description of the distribution of present-tense *will*, not a theoretical claim about how the restrictions are accounted for in the semantics. An analysis will be proposed in Chapter 4. I will claim that *will* is infelicitous when the speaker infers from a result state to its cause.

### 2.3.1 Sensitivity to evidence shift

The first challenge to the epistemic-only account of *will* is its behavior in contexts where the evidence is physically present, as in (39). In this example, the speaker has inferred from a

smoky smell that the neighbors are barbecuing. This inference can be reported using *must*, but it cannot be reported using *will*.

- (39) Smoky barbecue: Angela knows that her neighbors barbecue often. A friend is over at her house and they both smell something smoky. Angela says:
- a. #The neighbors will be barbecuing (right now).
  - b. The neighbors must be barbecuing (right now).

We might think that the difference is due to the difference in anaphoric requirements of *must* and PT *will*, as discussed in Section 2.2.1: because *must* is acceptable, the argument (rule + trigger) must be salient or easily accommodated, and maybe that is why *will* is not acceptable. It is easy to show, however, that this is not the case. If the context is switched to one with an inference that is clearly not contextually salient or easily accommodated (because *must* is unacceptable without explanation), as in (40), *will* is still infelicitous.

- (40) Ticking coffee: Cassy's neighbor Kimberly has an extremely odd coffee maker. When Kimberly brews coffee it ticks (tick, tick, tick). A friend is over at Cassy's house and they both hear the ticking. Cassy says:
- a. #Kimberly will be making coffee (right now).
  - b. #Kimberly must be making coffee (right now).
    - (i) ✓Kimberly must be making coffee (right now), her odd coffee machine makes that sound.

In the ticking coffee context, the trigger (ticking sound) is salient, but the rule (that ticking sounds are made by Kimberly's coffee maker) is not contextually salient or easily accommodated. We can tell that this is what makes *must* infelicitous in this context because adding a continuation with the rule, as in (40b-i), makes it felicitous.



The examples in (39) and (40) share a crucial property: the trigger is a result state (e.g., smoky smell, odd ticking noise), and the conclusion is the **cause** of the trigger (e.g., the neighbors barbecuing, or Kimberly making coffee).

The causal facts I refer to here are meant to be language enteral, as determined by naive speakers of the language. They are not meant to be metaphysical claims about causation. For this reason, I will use linguistic tests to determine whether one eventuality causes another (introduced in Section 2.4.2). Even though one eventuality might not technically cause another, the language might treat it as it does. For example, consider the (41) example below.

- (41) *Giants: John only drinks when he watches the Giants play. He calls you slurring his speech, clearly drunk. You say to a friend:*
- a. #The Giants will be playing right now.
  - b. The Giants must be playing right now.

We could debate whether this example involves causation—whether the giants playing actually caused John to get drunk. But what is relevant for the present purposes is whether the language treats it as a cause. In Section 2.4.2, I will present linguistic tests for causation. As a brief preview, we can consider whether the conclusion can occur as a *because* response to a *why* question about the evidence, as in (42).

- (42) *Giants context*
- A: Why is John drunk?
  - B: Because the Giants are playing.

In (42) B's response provides a cause or explanation (to be discussed in Section 2.4) for the conclusion—John being drunk. I take this to suggest that speakers treat the giants playing

as a cause for John's drunkenness. A similar example is given in the melting swan context, provided in (43).<sup>6</sup>

- (43) Melting swan: *There is a large swan sculpture in the middle of the party. It begins to melt, and you realize that it's made of ice, not glass. You say:*
- a. #The swan will be made of ice.
  - b. The swan must be made of ice.

We don't need to consider whether or not the swan being made of ice actually caused it to melt. It might be the fact that the swan is made of ice along with other factors, e.g., the temperature of the room, caused the swan to melt. Rather than considering these facts, we can rely on linguistic tests, such as the *why/because* test in (44).

- (44) *Melting swan context*
- A: Why is the swan melting?
- B: Because it is made of ice.

Below I will show that causation is a factor for determining the distribution of PT *will*. I will support these claims in Section 2.4.2 by employing linguistic tests that target causation. Because causation can be understood a number of different ways, it's important to note that the relevant notion is how (naive) speakers *understand* causation, not the metaphysical notion of causation itself. If the results of the linguistic tests differ from the metaphysical notion of causation, I expect that the distribution of *will* patterns with the linguistic tests. For this reason, the claims I make here about causation should all be understood as a claim about how the language treats causation, rather than a claim about metaphysics.

To see that *will* is sensitive to causation, consider a parallel example in (45) in which the causation is flipped: the conclusion is the **result** of the trigger.

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<sup>6</sup>This is an example of material abduction, to be discussed further in Section 2.4. Thanks to Kim Johnston for pointing out the relevance of this example to me.

- (45) Dowager barbecue: Adam has a guest that doesn't know what a barbecue is, the Dowager Countess of Grantham. Adam and the Dowager Countess are considering going outside for a walk. She has been talking to the neighbors and tells Adam that they said they are doing something called "barbecuing." Adam says, let's stay inside:
- a. It will be really smoky out there (right now).
  - b. #It must be really smoky out there (right now).

To keep this example minimally different from (39), there needs to be an interlocutor who cannot infer from the fact that someone is barbecuing to there being smoke outside. This is because *will* requires that the trigger or rule not be contextually salient (Chapter 1). If the interlocutor knew that barbecues caused smoke, just the mention of the barbecue should make that rule salient, and thus *will* might be unacceptable for some speakers.<sup>7</sup> A more natural example might be when talking to a child as in (46).

- (46) Paint fumes: Dad is painting his neighbor's kitchen. Reid wants to watch. Reid asks Mom if he can go next door and watch Dad paint. She knows that paint causes fumes so she says: You can't go over there...
- a. ✓It will be hard to breathe in there (right now).
  - b. #It must be hard to breathe in there (right now).
    - (i) ✓It must be hard to breathe in there (right now), painting smells really strong!

In this context, the trigger is the cause (Dad painting) and the conclusion is the result (It being hard to breathe in the kitchen). Notice that neither (45) nor (46) have a *when-we-check* or future interpretation. This is because the fact that it is smoky outside or that it's hard to breathe in the kitchen are reasons *not* to go check.

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<sup>7</sup>As discussed in Chapter 1, some speaker's find the use of *will* acceptable in (45) even if the interlocutor knows what barbecuing is.

The inferences are summarized in (47). In the smoky barbecue context (39), the trigger is a result state and the conclusion is the cause; this inference is schematized in (a). In the Dowager barbecue context (45), the trigger is the cause and the conclusion is its result; this inference is schematized in (b). Notice that it may be the case that every time there is a smoky smell, the neighbors are barbecuing, and every time the neighbors are barbecuing, there is a smoky smell. That is, the speaker might believe the biconditional in (c). Regardless, the grammar treats the inferences in (a) and (b) as distinct. *Will* can be used to express the inference represented in (b) but not the inference in (a).

	trigger		conclusion	
(47)	a. smoky smell (result)	→	neighbors barbecuing (cause)	= Smoky barbecue (39)
	b. neighbors barbecuing (cause)	→	smoky smell (result)	= Dowager barbecue (45)
	c. smoky smell	↔	neighbors barbecuing	

In determining the felicity of *will*, it matters whether the inference is from a result to a cause, as in (a), or from a cause to a result, as in (b). (39) and (45) are parallel except for the direction of causation of the inference. This difference in causal relation is something that *will* is sensitive to but *must* is not.

There are contexts where the conclusion in (39) *the neighbors are barbecuing* can felicitously be reported with *will*. One such context is the Friday night context in (48). Rather than the trigger being a result state or a cause, as in (39)-(46), the trigger is a temporally related eventuality. The rule (*if it's Friday, then the neighbors are barbecuing*) is based on the fact that the neighbors have a plan or a habit to barbecue on Friday nights.

(48) Friday night barbecue: Angela and Matt know that their neighbors barbecue every Friday night. They are out of town, and Angela realizes it's Friday night. Angela says:

- a. The neighbors will be barbecuing (right now).
- b. ?The neighbors must be barbecuing (right now).

- c. The neighbors must be barbecuing (right now), it's Friday night.

Note that the difference in felicity between (48b) and (48c) is accounted for by the anaphoric requirement of *must* discussed in Chapter 1.

We can use the *why/because* test to determine the causation between the two eventualities in (48). It is clear that the conclusion is not the cause of the trigger, i.e., the barbecuing doesn't cause it to be Friday night. Performing the *why/because* test with this configuration is difficult. This is because it is odd to ask why it is Friday night. We can instead perform the test for the opposite relation whether the conclusion is *caused* by the trigger. The relevant test is in (49).

(49) *Friday night barbecue context*

- A: Why are the neighbors barbecuing?      =conclusion  
B: Because its Friday night.                      =trigger

This test shows that the conclusion—that the neighbors barbecuing—is caused by the trigger—that it is Friday night). That makes the Friday night context, and other inferences based on time, similar to the Dowager barbecue context. It involves an inference from a cause (trigger) to a result/effect (conclusion). The time triggers are less obviously causes than other eventualities. What is relevant for *will*, however, is just that the trigger is not a result of the conclusion, and it is clear that the conclusion didn't cause the trigger. (50) gives more examples of the use of *will* in a context where the trigger is the time and day.

(50) CONTEXTS WITH TIME TRIGGERS

- a. Victoria will be in her office (right now).  
    (i) trigger: It's Tuesday at 11:30  
    (ii) rule: If it's 11-12 Tuesday, Victoria is in her office (office hours)  
    (iii) conclusion: Victoria is in her office
- b. There will be traffic on the 405 (right now).  
    (i) trigger: It's Friday at 5:00

- (ii) rule: If it's Friday, there is traffic on the 405
- (iii) conclusion: There is traffic on the 405

In (50a), the trigger—that it is Tuesday at 11:30—isn't caused by Victoria's being in her office. In (50b), that it is Friday at 5:00 is not caused by there being traffic on the 405. Since the time of day is rarely, if ever, a result state, the use of *will* with a time trigger is almost always felicitous.

This section has discussed three types of context: (i) the trigger is the result state of the conclusion; (ii) the trigger is the cause of the conclusion; and (iii) the trigger is a time. These are exemplified with additional examples in (51).

(51) MORE MINIMAL PAIR EXAMPLES

- i The band #will/must be practicing. trigger = result  
  - trigger: Loud music outside the gym
  - rule: if there is music outside the gym, the band is practicing.
  - conclusion: the band is practicing
- ii There will/must be loud music outside the gym. trigger = cause  
  - trigger: John says the band is practicing
  - rule: if the band is practicing, there is loud music outside the gym
  - conclusion: there is loud music outside the gym
- iii The band will/must be practicing right now. time trigger  
  - trigger: It's Thursday evening
  - rule: If it's Thursday evening, the band is practicing.
  - conclusion: The band is practicing.

Epistemic *must* is acceptable in all of these contexts, but PT *will* is only acceptable in (ii)-(iii).

### 2.3.2 Sensitivity to prejacent shift

In the previous section, I claimed that *will* is unacceptable in contexts where the trigger is the result of the conclusion. A possible alternative generalization is that *will* is instead incompatible with all physical evidence, as has been claimed for some evidentials variously described as “assumption” Aikhenvald (2004), “inference from reasoning” Willett (1988), “inferential” Murray (2010), and “assumed” Krawczyk (2012). In this section, I will show that this is not the case for *will*.<sup>8</sup>

In the smoky barbecue context, the use of *will* is felicitous when the speaker reports an inference that is based on the smoke, but it isn’t an inference about its cause. This is shown in (52).

- (52) *Drunken barbecue: Same as Smoky barbecue context (39), but this time Angela also knows that when the neighbors have barbecues, they get drunk.*
- a. #The neighbors will be barbecuing (right now).
  - b. The neighbors will be drunk (right now).

The drunken barbecue context (52) shows that *will* is compatible with a context in which the trigger is physical evidence, as long as the physical evidence isn’t the result of the conclusion. In (52), the speaker could infer from the smoky smell that the neighbors are barbecuing. This inference could not be felicitously reported with *will*. The speaker could also infer from the smoke that the neighbors are drunk. This inference can be reported with *will*.

Notice that the trigger—the smoky smell or the barbecue—is *not* the result of the drunkenness. This is supported by the *why/because* test in (53) and (54).

- (53) *Drunken barbecue context*
- A: Why is there smoke?
- B: #Because the neighbors are drunk.

---

<sup>8</sup>Thanks to an anonymous SALT reviewer for pointing out the significance of this data.

(54) *Drunken barbecue context*

A: Why are the neighbors barbecuing?

B: #Because they're drunk.

Notice that there are contexts in which B's *because* response in (54) is acceptable, namely when the neighbors barbecue every time they get drunk. This change in the context adds a causal link between barbecuing and getting drunk.

The example in (52) relies on a complex inference. In this context the speaker's inference has multiple steps: from the smoke to the neighbors barbecuing, then from the barbecuing to the drunkenness. The first step is an inference from a result state to its cause. This might seem to be a counter example to the generalization that *will* is incompatible with an inference from a result to its cause, but this is not the case. What is relevant to *will* is how the trigger relates to the conclusion.

Given this example, we might consider an alternative generalization in which *will* has an existential requirement that there is at least one inference that isn't from a result to a cause, and thus (52b) is acceptable because there is such an inference (from barbecuing to drunkenness). The two options are given in (55).

(55) POSSIBLE GENERALIZATIONS FOR *will*

- a. *will* is infelicitous when the trigger is the result state of the conclusion
- b. *will* is felicitous as long as at least one portion of the inference is not from a result state to its cause

I will provide two arguments against the alternative generalization in (55b). First, consider the blended context in (56).

(56) *Smoky barbecue and Friday night: Angela knows that her neighbors always barbecue on Friday nights. She realizes that it's Friday night. A friend is over and they both smell smoke. Angela says:*



- a. #The neighbors will be barbecuing.
- b. The neighbors must be barbecuing.

In this context, there are two possible inferences: (i) one in which the trigger is a time, Friday night, and (ii) one in which the trigger is a result state, the smokiness. If *will* had an existential requirement, as in (55b), we would expect it to be satisfied by the inference based on the time (i). This, however, is not the case because the use of *will* is unacceptable. This example might, however, be confounded by the saliency of the result state evidence, the smoky smell.

The second argument against the existential generalization in (55b) is a conceptual one. I expect that *will* could be used with much more complex inferences than the ones I have discussed here. Rather than considering each step in the inferential chain, the felicity of *will* is determined by comparing the trigger and the conclusion. To distinguish between these two analyses we would need a context in which the trigger is a result state and the conclusion is its cause, and there is also an intermediate link which is not from a result state to its cause.

From the drunken barbecue context (52) and the data discussed in Section 2.3.1, we can conclude that it's not the case that the use of *will* is incompatible with *any* inference based on physical evidence or any context with a trigger that is physical evidence. Instead, it is incompatible with inferences from result states to causes, i.e., contexts where the trigger is a result state of the conclusion.

### 2.3.3 Additional examples

The examples in Sections 2.3.1 and 2.3.2 were designed to show that *will* is infelicitous when the trigger is a result state of the conclusion. The relations used in the rules thus far are summarized in the figure below. The emerging generalization is that *must* is felicitous with reasoning of any sort (as long as it supports a universal claim), whereas *will* is infelicitous when the trigger is a result state of the conclusion.

The goal of this section is to provide additional examples to corroborate the data in the previous section. Specifically, these examples show that causation is the relevant factor for

Figure 2.2: Summary of inference types

Relation	ex	Example Inference		will	must
		trigger (t)	conclusion (c)		
t is result of c	(39)	There is smoke	Neighbors are barbecuing	#	✓
	(40)	There is ticking	Kim is making coffee	#	✓
t causes c	(45)	Neighbors are barbecuing	There is smoke	✓	✓
	(46)	Dad is painting	It is hard to breathe	✓	✓
t is temporal	(48)	Friday night	Neighbors are barbecuing	✓	✓
	(50)	It's Tuesday at 11:30	Victoria is in her office	✓	✓
	(50)	It's Friday at 5:00	There is traffic on the 405	✓	✓
correlated	(52)	There is smoke	Neighbors are drunk	✓	✓

the felicity conditions of *will*, rather than an aspect specific to the barbecue contexts. To do this, it is important to control for the anaphoric properties discussed in Chapter 1. It is clear that *will* is acceptable when the trigger or rule is not contextually salient. One easy way to do this is to use phone conversations. In (57) and (58), Laura and Kaeli are talking on the phone. Laura doesn't know that cookies are baking and can't smell/see the trigger. Moreover, we can tell that these are *will* contexts because *must* is infelicitous unless Kaeli explains her inference. Despite the fact that these contexts clearly satisfy the anaphoric requirement of *will*, it is infelicitous in both.

- (57) OLFACTORY RESULT TRIGGER *Kaeli and Laura are talking on the phone. Kaeli is baking cookies. Kaeli starts to smell burning and says: I should go...*
- a. #My cookies must be burning.
    - (i) My cookies must be burning, I can smell smoke.
  - b. #My cookies will be burning.

- (58) VISUAL RESULT TRIGGER *Kaeli and Laura are talking on the phone. Kaeli is baking cookies. She sees smoke coming from the oven and says: I should go...*
- a. #My cookies must be burning.
    - (i) My cookies must be burning, there is smoke coming from the oven.
  - b. #My cookies will be burning.

If instead the trigger is not a result state, the use of *will* is acceptable. This is shown in (59), in which the trigger is time passing and thus the conclusion is not the cause of the trigger (the cookies' burning doesn't cause time to pass).

- (59) VISUAL TIME TRIGGER *Kaeli and Laura are talking on the phone. Kaeli is baking cookies. She realizes Laura has been talking for a long time and says: I should go...*
- a. #My cookies must be burning.
    - (i) My cookies must be burning, you have been talking forever!
  - b. My cookies will be burning.

In (59), the trigger is not a result state of the conclusion. The speaker knows about how long it takes for cookies to be burning and concludes from the amount of time that has passed that the cookies are burning.

Again, as shown in section 2.3.2, the inference reported with *will* can be based on physical evidence (smell or sight of smoke), but the conclusion cannot be its cause. This is replicated in (60).

- (60) *Same as (57)-(58) with the addition that the speaker knows her cat hates smoke and hides when the kitchen is smoky.*
- a. My cat will be hiding (right now).

In this context, the speaker infers from the smoke that her cat will be hiding. The trigger is the cause and the conclusion is the result, and this inference can be reported with *will*. The examples in this section confirm the pattern found in Sections 2.3.1 and 2.3.2.

#### 2.3.4 Interim summary

The data presented in this section can be added to our list of empirical generalizations for *will* in (61).

(61) Empirical generalizations for PT *will*: (to be revised)

*will-p* can be uttered iff:

- (i) the speaker doesn't have direct evidence for *p*
- (ii) the trigger for the inference that concludes *p* is not its result state

If the speaker does not have direct evidence for *p* (a), then the speaker must have inferred *p*. The new condition in (b) assures that the trigger for that inference is not a result state of the conclusion *p*. Crucially, the second empirical generalization in (b) does not hold for epistemic *must*.

## 2.4 A classification of inference types

The goal of this section is to provide terminology to support the empirical generalization provided in the previous section. To be clear, this section doesn't provide an analysis; it just introduces terminology that is useful when discussing the aspects of the contexts that affect the acceptability of *will*. It also places the restriction of *will* within recent work on evidentials (namely Krawczyk (2012)).

All of the examples discussed so far involve one of three types of context in (62).

(62) CONTEXT TYPES

- |    |  |       |
|----|--|-------|
| a. | trigger is <b>the result of</b> conclusion | #will |
| b. | trigger is <b>the cause of</b> conclusion  | ✓will |
| c. | trigger <b>co-occurs with</b> conclusion   | ✓will |

The evidential requirement of *will* is different from the requirements of traditional evidential markers. What is relevant for *will* is the *relation* that holds between the trigger and the conclusion. It isn't the case that there is something intrinsic about the trigger that *will* is incompatible with.

To make a comparison with evidentials, what I have called triggers align with what is often referred to as evidence. Some evidentials encode restrictions on intrinsic properties of that evidence—for example, that that it be visual, auditory, or hearsay. In the case of a hearsay evidential, it is an intrinsic property of the evidence that it is a speech act. This is different from the restriction observed for *will*. What is relevant for *will* isn't that the trigger *is* a result state, but rather that it is a result state of the conclusion. Because *will* doesn't restrict the trigger, but instead restricts the relation between the trigger and the conclusion (the inference), I will say it has an *inferential restriction*, rather than an *evidential restriction*.<sup>9</sup>

In this section, I will move from discussing how the trigger relates to the conclusion to instead discussing properties of the relation between the two, i.e., the type of inference involved. In doing this, we switch from the context types in (62) to the types of inferences in (63).

(63) BASIC INFERENCE TYPES

- a. abductive
- b. deductive
- c. inductive

There is a unifying property of the inference used in the contexts in (62). The context in which *will* is infelicitous in (62a) involves as abductive inference, whereas the contexts in

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<sup>9</sup>This may also be the right way to think about indirect and direct evidentials. What is direct evidence for one proposition may be indirect evidence for another.

which *will* is felicitous in are non-abductive (I'll group deductive and inductive together for present purposes). I will focus on cases of abductive inferences that involve inferring from a result to a cause, but this classification makes additional predictions about contexts that *will* can occur in. In the next section, I will briefly discuss one such case and show that *will* is incompatible in this context as well.

Krawczyk (2012) claims that all evidentials require abductive reasoning but epistemic modals do not. In this section, I will show that not only does present-tense *will* not require abductive reasoning, it is in fact incompatible with it. The rest of this section will precede as follows: Section 2.4.1 gives an overview of abductive inferences. Section 2.4.2 provides independent linguistic tests for abductive inferences and shows that the contexts that *will* cannot occur in all contain abductive reasoning.

#### 2.4.1 Abductive versus non-abductive inferences

Abductive reasoning was first introduced by Pierce (Peirce 1955) and is defined as an inference from some event to the best-fit explanation for that event. What it takes for an explanation to be “best-fit” is outside of the scope of the present project. What will matter for present purposes is simply whether the conclusion is an explanation for the trigger at all. This will be enough to explain the distribution of *will*.

Pierce's conception of abductive reasoning has been argued to have the logical form of “*inverse modus ponens*,” as defined below.

(64) MODUS PONENS:  
If P, then Q. P. Therefore, Q.

(65) INVERSE MODUS PONENS:  
If P, then Q. Q. Therefore, P.

For this reason, abduction is also called “retroductive” reasoning. A definition is given below. In this definition, the “observation” corresponds to the trigger in the previous contexts discussed. I will continue to use the term *trigger*.

(66) PIERCE’S ABDUCTIVE/RETRODUCTIVE REASONING

The surprising fact *C* is observed.

But if *A* were true, *C* would be a matter of course.

Hence, there is reason to suspect that *A* is true.

Below are two examples of abductive and non-abductive inferences. In the first, the trigger is that the streets are wet. If one concludes that it rained, there is an explanation for the fact that the streets are wet.

(67) EXAMPLE: ABDUCTION

(Surprisingly,) The street is wet.

When it rains, the streets become wet.

Therefore, it rained.

If instead the trigger and conclusion are switched, the inference is no longer abductive. In (68), the trigger is that it is raining. Now concluding that the streets are wet does not explain the trigger.

(68) COMPARE WITH: NON-ABDUCTIVE

It rained.

When it rains, the streets become wet.

Therefore, the streets are wet.

Note that in (68) the conclusion that the streets are wet might explain how the speaker *knows* that it is raining, but it does not explain the rain itself. For simplicity, I will often take ‘abductive’ reasoning to be synonymous with reasoning from a result or effect to its cause.

Again, the definition of causation relevant here is that of naive speakers, not necessarily the metaphysical definition of causation.

It is important to note that there are both *abductive rules* and *abductive reasoning*. The argument in (69) is an example of deductive reasoning.

(69) EXAMPLE OF DEDUCTIVE REASONING

The neighbors are barbecuing.  $\rightarrow$  There is smoke.

The neighbors are barbecuing.

---

$\therefore$  There is smoke.

In contrast, the argument in (70) is an example of abductive reasoning. Notice the argument is not logically valid; the premises do not entail the conclusion.

(70) EXAMPLE OF ABDUCTIVE REASONING

The neighbors are barbecuing.  $\rightarrow$  There is smoke.

There is smoke.

---

The neighbors are barbecuing.

(71) is an example of deductive reasoning applied to a premise set with an abductive rule. This is a logically valid inference, but it involves an abductive rule.

(71) EXAMPLE OF DEDUCTIVE REASONING WITH ABDUCTIVE RULE

There is smoke.  $\rightarrow$  The neighbors are barbecuing.

There is smoke.

---

$\therefore$  The neighbors are barbecuing.

*Will* is infelicitous if any aspect of the inference is abductive, whether it is the rule or the actual reasoning. To discuss the distribution of *will*, we need to discuss the arguments in both (70) and (71). I will use the term ‘abductive inferences’ to refer to both of these arguments.



The first premise in (71) is categorized as an abductive rule because the antecedent is the result state of the eventuality of the consequent. It involves reasoning from the truth of a result to the truth of its cause. The first premise in (69) is the opposite. The consequent is the result state of the eventuality of the antecedent. It involves reasoning from the truth of a cause to the truth of its result state.

This suggests that there is much more to abduction than can be modeled using material implication, simply concluding the truth of an antecedent from the truth of a consequent (i.e., inverse modus ponens). The argument schemas in (70)-(71) are gross simplifications of how abductive reasoning should be modeled. Krawczyk (2012) following Lipton (2003) models abductive reasoning in terms of conditional probabilities, as in (72). The observation  $e$  is what I have called the trigger.  $a$  is the agent—in assertions, the speaker—and  $K_a$  is the knowledge of the agent. In the case of modals,  $p$  is the prejacent.

(72) BEST-FIT EXPLANATION

In an evidence context  $C_{EV}$ , where  $e$  is an observation to be explained by an agent  $a$ ,

a. There is a proposition  $p$ , where

(i)  $p, \neg p \notin K_a$ , and

(ii)  $p$  is an explanation for  $e$ , such that  $Pr((K_a + e) | p) > Pr((K_a + e) | \neg p)$

b. There is a proposition  $q$ , where

(i)  $q, \neg q \notin K_a$ , and

(ii)  $q$  is an alternative explanation for  $e$ , such that  $Pr((K_a + e) | q) > Pr((K_a + e) | \neg q)$

where  $p$  is the Best-fit Explanation of  $e$  if and only if

(i)  $Pr(q)$  is extremely low

(ii)  $Pr(p) \gg Pr(q)$ , and

(iii)  $Pr((K_a + e) | p) \gg Pr((K_a + e) | q)$

The basic idea is that the prejacent  $p$  is an explanation of an observation  $e$  if the probability of observing  $e$  is higher if  $p$  is true than if  $p$  were not true. Moreover, the explanation is a Best-

Fit Explanation only if the probability of  $p$  is higher than the probability of an alternative explanation  $q$  and the probability of  $e$  given the observation  $p$  is higher than the probability of  $e$  given  $q$ .

In all of the examples I have provided so far (besides the melting swan context), the abductive inferences have involved reasoning from a result state to a cause. In terms of the definition of abduction in (72), a cause is the Best-Fit Explanation for a result state. For example, the probability of observing a smoky smell is much higher when the neighbors are barbecuing than when they are not.

#### 2.4.2 Tests for inference type

In this section, I will introduce two independent linguistic tests for abductive inferences. In every context that these constructions are acceptable, the use of PT *will* is unacceptable. This demonstrates two points: (i) abductive inference is something that the grammar is sensitive to independently of *will*; and (ii) PT *will* is incompatible with these inferences.

##### 2.4.2.1 Apparently

Krawczyk (2012) claims that the English adverbial *apparently*, along with other lexical items that encode evidentiality, requires that the speaker use abductive reasoning to conclude its propositional complement. Consider the use of *apparently* with the example abductive and non-abductive inferences above.<sup>10</sup>

(73) Abductive inference: Noah and Chris see that the streets are wet. Chris says:  
Apparently it rained.

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<sup>10</sup>There is more to be said about *apparently*—for example, how it behaves when the speakers have direct evidence (see Rett and Murray (2013)).

- (74) Non-abductive inference: Noah and Chris hear the weather report say that it is currently raining in Santa Cruz. Chris says:  
#Apparently the streets are wet (in Santa Cruz).

Notice that in (74) Chris could say *Apparently it's raining in Santa Cruz*. This is because the best explanation for why the weather report said it rained is that there is actually rain. For a more complete discussion of these facts, see Krawczyk (2012). If Krawczyk (2012) is right and *apparently* requires an abductive inference, then it can be used as a test for whether a context/conclusion pair constitutes an abductive inference. Moreover, if *will* is in fact incompatible with abductive inferences, we expect *will* and *apparently* to have opposite acceptability patterns. In this section, I will return to the various contexts discussed in Section 2.3 and show that this complementary behavior is in fact what we find.

In the smoky barbecue context introduced in (39), the speaker smells smoke and concludes that the neighbors are barbecuing. The conclusion that the neighbors are barbecuing is a (best-fit) explanation for why there is smoke; the inference is abductive. This inference can be reported with *apparently* (75a), but it cannot be reported with *will* (75b).

- (75) *Smoky barbecue context: trigger = there is a smoky smell*
- a. ✓ *Apparently* the neighbors are barbecuing.
  - b. #The neighbors will be barbecuing.

This can be compared to the felicity of *will* and *apparently* when they occur in the drunken barbecue context (52). In this context, the speaker observes a smoky smell and infers that the neighbors are drunk (as they always are when they have a barbecue). This conclusion is *not* an explanation (let alone a best-fit one) for why there is a smoky smell, so it is non-abductive. This inference can be reported with *will* (76b), but it cannot be reported with *apparently* (76a).

- (76) *Drunken barbecue context: trigger = there is a smoky smell*
- a. #*Apparently* the neighbors are drunk.

- b. ✓The neighbors will be drunk.

Notice that if the relevant trigger is a result of the drunkenness (e.g., shouting or loud music), then the felicity of *apparently* and *will* flips.

The same felicity pattern found in (76) is also found in the Friday night context from (48). In this context, the speaker observes that it is Friday night and concludes that the neighbors are barbecuing. This conclusion is not an explanation for why it is Friday night; the inference is not abductive. Again, the inference can be reported with *will* (77b), but it cannot be reported with *apparently* (77a).<sup>11</sup>

(77) *Friday night context: trigger = it's Friday night*

- a. #Apparently, the neighbors are barbecuing.
- b. ✓The neighbors will be barbecuing.

The same felicity pattern is also found when the trigger is a cause and the conclusion is its result. In the Dowager barbecue context from (45), the trigger is that the neighbors are barbecuing, and the conclusion is that there is smoke outside. This conclusion is not an explanation for why the neighbors are barbecuing; the inference is not abductive. Again, the inference can be reported with *will* (78b), but it cannot be reported with *apparently* (78a).

(78) *Dowager barbecue: trigger = the neighbors are barbecuing*

- a. #Apparently there is smoke outside.
- b. ✓There will be smoke outside.

Finally, recall that the melting swan context provides an example in which the conclusion isn't transparently the cause of the trigger. This inference is, however, compatible with *appar-*

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<sup>11</sup>Note that (77a) is felicitous if we add to the context that the speaker was told that the neighbors plan to barbecue. This is because *apparently* is compatible with hearsay evidence, as discussed in the weather report example in (74). Krawczyk (2012) argues that hearsay evidence also represents an abductive inference.

*ently*. This suggests that the language treats the inference as abductive (from a result state to a cause). As expected, *will* is incompatible with this inference.

(79) *Melting swan: trigger = swan sculpture is melting*

- a. ✓ Apparently the swan is made of ice.
- b. #The swan will be made of ice.

The distribution of *apparently* is in complementary distribution with PT *will*. If we accept Krawczyk's (2012) claim that *apparently* requires an abductive inference, this shows that *will* is incompatible with abductive inferences.

#### 2.4.2.2 Why/because

The second linguistic test uses *why* questions with *because* answers. The intuition is that a *because* response provides a relevant explanation to the *why* question and is thus a marker of abduction. We can therefore use it as a test for whether a conclusion *explains* a trigger. This is schematized in (80). Whenever (80a-ii) is a good/felicitous answer to (80a-i), *will* should be infelicitous with that trigger/conclusion and vice versa.

- (80) a. *Why/because test:*
- (i) Why *trigger*?
  - (ii) ?Because *conclusion*.
- b. ?*will-conclusion*

Let's first consider the smoky barbecue context. In this context, the trigger is that there is smoke; this is used to form the *why* question in (81a-i). The conclusion is *the neighbors are barbecuing*; this is used to form the *because* answer in (81a-ii).

(81a-ii) is a good answer to the question in (81a-i). This shows that concluding that the neighbors are barbecuing from the trigger that there is smoke is an abductive inference.

The use of *will* in (81b) is infelicitous, as is expected if *will* is incompatible with abductive reasoning.

(81) *Smoky barbecue context*

a. *Why/because test:*

(i) Why is there smoke?

(ii) ✓Because the neighbors are barbecuing.

b. #The neighbors will be barbecuing.

In (82), the trigger is the same: there is smoke. Rather than inferring the cause of the smokiness, the speaker infers that the neighbors are drunk. In (82), the answer *because the neighbors are drunk* is not a good answer to the question in (82a-i). Thus, the inference from the smoky smell to the fact that the neighbors are drunk is not abductive. The use of *will* in (82b) is felicitous, as is expected if *will* is compatible with non-abductive reasoning.

(82) *Drunken barbecue context*

a. *Why/because test:*

(i) Why is there smoke?

(ii) #Because the neighbors are drunk.

b. ✓The neighbors will be drunk.

The *why/because* test is trickier to apply in the Friday night barbecue context. This is because the observation is the day of the week and time. Asking why it is a particular day of the week or time is very odd. Asking why someone *thinks* it is a particular day is sensible, but asking why it is a particular day is very odd. Certainly, it isn't Friday *because* the neighbors are barbecuing.

(83) *Friday night barbecue*

a. *Why/because test:*

- (i) Why is it Friday night? (infelicitous question)
  - (ii) #Because, the neighbors are barbecuing.
- b. ✓The neighbors will be barbecuing.

Because there is no explanation for why it is a particular day or time, any inference based on time will be non-abductive, and thus *will* is always felicitous with these types of observations. Notice that (83) may be able to have an interpretation as in (84).

(84) *Kimmy lives in a bunker and can only tell the day of the week by looking out a small hole and observing what the neighbors are doing.*

- a. *Why/because test:*
- (i) Why **do you think** it is Friday night?
  - (ii) ✓Because the neighbors are barbecuing.

In (84), the neighbors' barbecuing isn't an explanation for why it is Friday but instead is an explanation for why Kimmy thinks that it is Friday. Her thought that it is Friday is explained by the neighbors' barbecuing.

This test works better with a temporally related example that doesn't rely on a time or day but instead involves two events occurring at the same time. An example is given in (85).

(85) *Mrs. Mateu's office hours are at noon. The bell in Royce Hall rings at noon. You hear the bell ringing.*

- a. *Why/because test:*
- (i) Why is the bell ringing?
  - (ii) #Because Mrs. Mateu is in her office.
- b. ✓Mrs. Mateu will be in her office.

The trigger in this context is the bell ringing. The *why* question asks why the bell is ringing. Responding *because Mrs. Mateu is in her office* is an infelicitous answer. In this context, it is felicitous to say *Mrs. Mateu will be in her office*.

In this context, a felicitous response to the question *Why is the bell ringing?* is *because it is 3:00*. As expected, if this is a good answer, then the content of the *because* clause cannot be asserted with *will*, as in (86b).

- (86) *Mrs. Mateu's office hours, the bell rings*
- a. *Why/because test:*
    - (i) Why is the bell ringing?
    - (ii) ✓Because it is 3:00.
  - b. #It will be 3:00.

The next context involves a trigger that is the cause and a conclusion that is the result. In the Dowager barbecue context, repeated below, the *why* question is formed with the cause: *Why are the neighbors barbecuing?* The *because* response contains the result: *Because there is smoke outside*. The *because* response is infelicitous, showing that the inference considered to be not abductive. As expected, the use of *will* in this context is felicitous. This is shown in (87b).

- (87) *The Dowager Countess tells you someone is "barbecuing."*
- a. *Why/because test:*
    - (i) Why are the neighbors barbecuing?
    - (ii) #Because there is smoke outside.
  - b. ✓There will be smoke outside.

Finally, we can return to the context with a conclusion that isn't clearly a cause of the trigger: the melting swan context. In this context, the *why* question is formed with the observation that the swan sculpture is melting. The conclusion is an explanation of why the swan is melting:



because it is made of ice. This explanation is a good *because* response to the *why* question. This suggests that the language treats the conclusion (that the swan is made of ice) as a cause for the trigger (the melting). As expected, *will* is infelicitous in this context.

(88) *The swan sculpture begins to melt*

- a. *Why/because test:*
  - (i) Why is the swan melting?
  - (ii) ✓ Because it's made of ice.
- b. #The swan will be made of ice.

This section has shown that the acceptability of *because* responses is in complementary distribution with the acceptability of *will*. If a *because* response requires an abductive answer (an explanation), then this test shows that *will* has the opposite requirement: it is incompatible with an abductive conclusion.

### 2.4.3 Final empirical generalization for *will* (Part I)

The *apparently* test and the *why/because* test converge on the same conclusion: *will* is incompatible with abductive reasoning. Given this, the empirical generalization for PT *will* can be restated as in (89).

(89) Empirical generalizations for PT *will*: (final for Part I)

- a. *will-p* can be uttered iff:
  - (i) the speaker doesn't have direct evidence for *p*
  - (ii) The inference that supports *p* is not abductive.  
i.e., *p* is not a (best-fit) explanation of the trigger

The updated terminology makes clear that *will* restricts the inference (i.e., the relation between the trigger and the conclusion) rather than the evidence. This generalization also covers

inferences that are *explanations* that don't necessarily involve causation (such as the melting swan example). These inferences were not ruled out by the previous generalizations in (61).

From these generalizations, a question arises as to why a future marker might also be used to express present non-abductive inference. Section 2.6 shows that this is a common cross-linguistic pattern, meaning that it is not an accident of English that *will* carries this inferential restriction.

## 2.5 Obviations of the inferential requirement

One might wonder whether all uses of *will* require a non-abductive inference. One context in which this requirement seems to be obviated is in the consequent of some conditionals. Other matrix uses of *will* are discussed in Chapter 6. Matrix uses of *will* seem to involve relating two eventualities or propositions: the trigger and the conclusion. Similarly, conditional sentences relate two eventualities: that of the antecedent and of the consequent. The two forms are given in (90).

- (90) a. (*It's 5:00,*) the neighbors will be barbecuing.  
b. If it's 5:00, then the neighbors will be barbecuing.

A naive theory might take the trigger to correspond to the antecedent of a conditional, and the conclusion to correspond to the consequent, as schematized in (91).

- (91) If *trigger*, then *will-conclusion*

If the correspondence in (91) is correct, then the generalization for *will* put forth in Section 2.3 would predict that a conditional should be infelicitous when the antecedent is a result state of the consequent. As shown in (92), this prediction does not seem to borne out.

- (92) a. If it is smoky outside, then the neighbors will be barbecuing.  
b. If there are wet umbrellas, then it will be raining.

There is evidence, however, that some conditionals do show the same sensitivity to causal relations that was observed for *will* in matrix clauses. I will discuss two types of evidence: First, Schulz (2007) claims that certain readings of counterfactuals are not available when the antecedent is a result cause of the consequent. Second, the “not counterfactuals” discussed by Henderson (2010) show a similar sensitivity to causal relations as was observed for PT *will*. I will discuss each of these points in turn.

Consider the counterfactual sentences in (93)-(94). In the (a) sentences the antecedent is a result state of the consequent. In the (b) sentences the causal relation is flipped.

- (93) a. If it were smoky outside, then the neighbors would be barbecuing.  
b. If the neighbors were barbecuing, then it would be smoky outside.
- (94) a. If there were wet umbrellas in the hallway, then it would be raining.  
b. If it were raining, then there would be wet umbrellas in the hallway.

The (a) sentences are acceptable in a context in which we’re debating whether or not the neighbors are barbecuing. We find out that it isn’t smoky. Someone says: *if it were smoky outside, the neighbors would be barbecuing, but its not, so they aren’t*.<sup>12</sup>

Schulz (2007) claims that counterfactuals are systematically ambiguous between an ontic and epistemic interpretation. She claims that the ontic reading is not available when the antecedent is a result of the consequent. This means that the (a) sentences in (93)-(94) only have an epistemic reading, whereas the (b) sentences are ambiguous between an epistemic and ontic reading.

Schulz (2007) analyses the difference between ontic and epistemic readings of counterfactuals as a difference in how the information state is updated. The ontic reading involves a local belief revision, whereas the epistemic reading involves global belief revision. She points out

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<sup>12</sup>Some speakers prefer (i) with *have to* in the consequent.

- (i) If it were smoky outside, then the neighbors would have to be barbecuing.

that the ontic and epistemic readings are often difficult to distinguish, but that the difference can be drawn out in certain contexts, for example (95).

(95) *Last night the duchess was murdered in her sleep. You are supposed to find the murderer. Soon after the investigations started the lab calls. They have found fingerprints of the butler all over the crime scene. You interrogate the butler and he confesses. At this state you believe that the butler did it, and that the gardener had nothing to do with it. Somewhat later the lab calls again. They have checked all the locks of the house. None is broken. There are only two persons besides the duchess that have keys for the house: the butler and the gardener. Now, you believe:*

If the butler had not killed her, the gardener would have.      =(42) Schulz (2007)

In (95), the sentence is false under an ontic reading, but true under an epistemic reading. Schulz (2007) points out that the epistemic reading is marginal.<sup>13</sup>

Another example to demonstrate this difference is given in (96). In this context, the eventualities of the antecedent and the consequent are correlated, but not causally related (both the low barometer and storm share a common cause, the low air pressure).

(96) *Suppose tempests are correlated with a low barometer. Further suppose we took the bridge instead of the ferry because of the low barometer and there was, in fact, a storm.*

- a. Thank goodness, if the barometer hadn't been low, we would have taken the ferry and we might have all drowned in the storm.
- b. No no no, if the barometer hadn't been low, there wouldn't have even been a storm.

The sentence in (96a) is an ontic counterfactual. It is a case of local revision because only the barometer reading is changed in the worlds of evaluation for the consequent, not other eventualities which are causally related to this eventuality. For example, it isn't taken into

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<sup>13</sup>I should note that the sentence in (95) is simply false for me and those I consulted.

consideration that if the barometer was not low, then the air pressure also wasn't low and the storm would not have happened. Instead, these other facts about the world stay fixed, only the barometer reading is changed, and the consequent worlds are evaluated relative to this updated information state. In contrast, these causally related events are taken into consideration for the epistemic reading, which according to Schulz involves global belief revision. This reading is represented in (96b). In the epistemic counterfactual, the information state is updated not only to remove the fact that the barometer had been low, but also all other information that it relies on (i.e., the air pressure and whether there was a storm). The consequent is evaluated relative to this globally revised information state.

Schulz (2007) claims that ontic counterfactuals do display the same behavior that was observed for PT *will* in Section 2.3. If the prohibition against inferring from a result state to its cause is a property of *will*, it remains a puzzle why epistemic counterfactuals do not also show this behavior.

Henderson (2010) discusses a different counterfactual form: "not counterfactuals" (NCs). An example of an NC is given in (97). These counterfactuals involve an antecedent of the form *if not for...*

(97) If not for Mary going to the store, we wouldn't have salsa. =(1) Henderson (2010)

In many cases, standard counterfactuals and NCs seem to have an interchangeable interpretation. Henderson shows, however, that NCs differ from standard counterfactuals in two ways. First, the antecedent of an NC is presupposed to be counter to fact. Second, NCs only allow an ontic counterfactual reading, not an epistemic one. The second point will be the focus here.

Consider again the context in (96). Recall that (96a) receives an ontic (local revision) reading, whereas (96b) receives an epistemic (global revision) reading. The parallel sentences with NC forms are given below in (98).

(98) *Suppose tempests are correlated with a low barometer. Further suppose we took the bridge instead of the ferry because of the low barometer and there was, in fact, a storm.*

- a. Thank goodness, if not for the low barometer, we would have taken the ferry and we might have all drowned in the storm.
- b. #No no no, if not for the low barometer, there wouldn't have even been a storm.  
=(19) Henderson (2010)

The ontic reading of the counterfactual in (96a) can occur in an NC, as in (98a). In contrast, the epistemic reading of the counterfactual in (96b) cannot occur in an NC, as in (98b). The only reading possible for (98b) is that somehow the low barometer *caused* the storm.

This difference between NCs and typical counterfactuals can also be seen in comparing the typical counterfactuals in (93) with their NC counterparts in (99).

- (99)
- a. #If not for the smoke, the neighbors wouldn't be barbecuing.
  - b. If not for the neighbors barbecuing, there wouldn't be some.
  - c. If not for it being Friday, the neighbors wouldn't be barbecuing.

Just like (98b), the sentence in (99a) only has an odd interpretation in which the smoke has caused the neighbors to barbecue. This shows that even though standard counterfactuals don't seem to behave as the naive correspondence and the empirical generalizations for *will* in Section 2.3 would predict, NCs so seem to behave as predicted. The felicity of the sentences in (99) are what we would expect of the NC sentences if the antecedent corresponded to the trigger and the conclusion corresponded to the consequent, as in (100).

- (100) If not *trigger*, then will not *conclusion*.

There are, however some differences between matrix PT *will* and NCs. NCs seem to require a (direct) causal relation between the antecedent (trigger) and the consequent (conclusion). That is, the antecedent must be the cause of the consequent. This differs from the matrix uses of *will* which only requires that the trigger not be the result of the conclusion. This difference can be seen in the drunken barbecue context, repeated below.

- (101) *Drunken barbecue: Angela knows that her neighbors barbecue often. A friend is over at her house and they both smell something smoky. Angela also knows that when the neighbors have barbecues, they get drunk. She says:*
- a. The neighbors will be drunk.
  - b. #If not for the smoke, the neighbors wouldn't be drunk.

In the drunken barbecue context, the use of *will* in (101a) is acceptable. This context satisfies the non-abductive requirement of PT *will* because the smoke (trigger) is not a result state of the neighbors being drunk (conclusion). The NC sentences seem to have a stronger requirement. (101b) is similar to (98b) in that it is only acceptable if the smoke is caused by the drunkenness. Unlike with matrix uses of *will* the antecedent not being the result state of the consequent is not enough, rather the antecedent must be the cause of the consequent. For (101b), this means that smoke must be the cause of the neighbors barbecuing.

In sum, conditional sentences seem to be one context in which the non-abductive requirement of *will* is obviated. Under a naive analysis in which the trigger corresponds to the antecedent and the conclusion to the consequent, some *will* conditionals and counterfactuals seem to allow an inference from a result state to a cause. It may be that the non-abductive requirement of *will* is not actually obviated, but that the naive mapping of the trigger/conclusion onto the conditional is incorrect. It does seem to be the case, however, that some conditionals do behave as the naive mapping would predict. Schulz (2007) has claimed that ontic counterfactuals are incompatible with this type of inference, and Henderson's (2010) not-counterfactuals show a similar pattern.

## 2.6 Replicating the English pattern in other languages

Aikhenvald (2004) states that future markers are used across languages to express a present inference. Recent work has discussed this use of future tense markers in Hindi (Kush 2011), Spanish (Rivero 2014), Romanian (Mihoc 2012), Bulgarian (Rivero and Simeonova 2014), Italian, and Greek (Giannakidou and Mari 2014). These authors report that the present inter-

pretation is inferential, but different inference types are not systematically compared.<sup>14</sup> I will return to the analyses proposed by these authors in Chapter 6.

This section focuses on addressing two questions. The first is: How widespread is this evidential strategy? The second is: Of the languages that employ this strategy, how many obey the inferential restriction observed for *will*?

(102) CROSS-LINGUISTIC VARIATION IN FUTURE MARKERS (PART 1)

- a. *Employs future evidential-strategy*: Does the language use its future marker to express present inference?
- b. *Obeys inferential restriction*: Is the present inference interpretation only licensed with a non-abductive inference?

To briefly answer this question up front, this section shows that a number of typologically unrelated languages employ this strategy of using future tense markers to also mark present inference. All of the languages surveyed that do use this strategy (seven out of eleven) also show the same inferential restriction observed with *will*. They are infelicitous if the speaker infers the prejacent proposition using an abductive inference.

The data presented here is from a small informal cross-linguistic survey of future markers. The goal of this is just to show that the English pattern is not accidental—there are a number of languages that use a future tense marker for present inference (as (Aikhenvald 2004) noticed)—and that the inference is restricted to non-abductive inferences.

It is important to point out, however, that not all languages use their future tense marker for present inference. For example, a sentence with a future tense marker cannot have a present interpretation in Japanese (Yu Tanaka, p.c.), French (Dominique Sportiche, p.c.), Hebrew (Yael Sharvit, p.c.), and Tagalog (Maayan Abenina-Adar, p.c.). The remainder of this section will focus on languages that do employ the future evidential strategy. It remains an open question why some languages employ this strategy and others do not.

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<sup>14</sup>Mihoc (2012) discusses cases of an inference from a result to a cause, but the examples provided are all cases of what I will call the “Anaphoric Construction”. This is the topic of Chapter 3.



Just like in Section 2.3, the crucial contexts involve varying abductive inferences and non-abductive ones. For example, in (103), the speaker's inference is non-abductive because the trigger *that it is 6:00* is not explained by or caused by the conclusion *that the neighbors are having a party*. In contrast, in (104), the speaker's inference is abductive because the trigger *that there is loud music* is explained and caused by the conclusion *that the neighbors are having a party*.

(103) Non-abductive context: *You know your neighbors have loud dinner parties every Friday night between 6-8pm. You're out of town, but notice that it is 7pm on a Friday. You say:*

The neighbors will be having a party

(104) Abductive context: *You know your neighbors often have loud dinner parties. You hear music coming from their apartment and say:*

#The neighbors will be having a party

The contexts used to elicit the judgments in the different languages vary slightly, but they all follow this basic pattern. In the non-abductive context the trigger is a time, and in the abductive ones the trigger is a result state of the conclusion.

The first languages surveyed are **Spanish** and **Catalan**. In both languages, the future tense marker is realized morphologically as a suffix on the verb, as shown in (105)-(106).<sup>15</sup> These sentences both have present temporal reference, and thus Spanish and Catalan do employ the future evidential strategy.<sup>16</sup>

(105) Los vecinos estar-án dando una fiesta.  
the neighbors are-fut having a party  
*The neighbors will be having a party.*

Spanish

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<sup>15</sup>Thanks to Victoria Mateu for the Spanish and Catalan data.

<sup>16</sup>Whether or not the sentence has a present interpretation was determined in the same way as was done for English. The sentence has present time reference if the truth conditions of the sentence require that the eventuality is ongoing during the utterance time.

(106) Els veïns       estar-**an** donant una festa.  
the neighbors are-fut having a party  
*The neighbors will be having a party.* Catalan

(105) and (106) are acceptable in the non-abductive context (103), but they are unacceptable in the abductive one (104).

In **Turkish**, the same pattern holds.<sup>17</sup> For example, if John said he would be working on the roof today, and the speaker hears pounding from the roof, she cannot felicitously report this abductive inference with (107).

(107) Can gati-da kalis-**acak**  
John roof-loc work-fut  
*John will be working on the roof.* Turkish

In contrast, in a non-abductive context, the speaker can mark a present inference with the future marker. For example, if the speaker knows John is always in his office between 9:00-5:00, and it is 2:00, and someone asks where John is, she can say (108).

(108) Can ofis-in-de ol-**acak**.  
John office-gen-loc be-fut  
*John will be in his office.* Turkish

In sum, Turkish has the same pattern found in English: the future tense marker can be used to mark present inference, but it is only compatible with a non-abductive inference.

The same pattern holds in Dutch, German, Greek, Hindi, and Korean *ilkkeoya*.<sup>18</sup> For all the languages surveyed, if the future tense marker could be used for present inference, then it also obeyed the inferential restriction.

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<sup>17</sup>Thanks to Sozen Ozkan for Turkish data.

<sup>18</sup>Thanks to Jos Tellings for the Dutch judgements, Viola Schmitt for German, Nikos Angelopoulos for Greek, Pranav Anand for Hindi, and Yun Kim for Korean.

## 2.7 Summary

This chapter showed that both *will* and *must* are incompatible with direct evidence and thus signal that the speaker has inferred the prejacent proposition. Traditionally, evidential markers in evidential languages are claimed to encode information about the evidence itself. These languages have lexical items that are claimed to have “evidential” restrictions, requiring that the speaker have a particular *type* of evidence. In this chapter, I have argued that, for English, the epistemic modals do not make a distinction in the type of evidence for a proposition but instead show restrictions based on how information is inferred from evidence. Specifically, *must* is compatible with any type of inference, but *will* is not compatible with abductive ones. I will refer to this as the “inferential restriction” of *will*. The next chapter provides additional evidence for the claims in this chapter.

This chapter also showed that other future markers are co-opted for present inference, and they too carry the same inferential restriction that *will* does. This raises a question about what the connection is between the semantics of future time reference and non-abductive inferences, given that they are so often lexicalized together.

This suggests that it is not an accident that *will* requires a non-abductive inference, but instead there is a natural connection between future tense marking and non-abductive inferences. As discussed in the beginning of this chapter, all claims about the future necessarily involve an inference. This is because one cannot, in the present, directly perceive an eventuality in the future, unlike present and past eventualities. Moreover, all inferences about the future are necessarily not abductive. If an eventuality holds in the future, and has not yet occurred, its result state also holds in the future. If the result state holds in the future, then it cannot, in the present, be perceived. The trigger for a future claim will never be a result state of that eventuality. Thus, all claims about the future involve a non-abductive inference. This is exactly the requirement that was observed for PT *will* in this chapter.

## CHAPTER 3

### Anaphoric Construction

The final challenge to an epistemic-only account of PT *will* is the felicity of *will* within a specific construction, exemplified in (109) and (110). In (109), the speaker smells smoke and infers that the neighbors are barbecuing. If the prejacent is *the neighbors be barbecuing*, then the inference cannot be felicitously reported with *will*, as shown in (109b). If, instead, the prejacent is *that be the neighbors barbecuing*, the inference can be felicitously reported with *will*, as in (109a). *Must* shows no sensitivity to the different forms (cf. (109c) v. (109d)).

- (109) *Smoky barbecue: Angela knows that her neighbors barbecue often. A friend is over to her house and they both smell something smoky. Angela says:*
- a. That will be the neighbors barbecuing.
  - b. #The neighbors will be barbecuing.
  - c. That must be the neighbors barbecuing.
  - d. The neighbors must be barbecuing.

I will refer to the sentences in (109a) and (109c) as the *Anaphoric Construction* (AC) because, as I will show in Section 3.1.1, the subject is anaphoric to the trigger. I will refer to (109b) and (109d) as their *Non-Anaphoric* (NA) counterparts.

This chapter will focus on the AC and compare it with the NA counterpart. It will examine the Anaphoric Construction and make the following claims: the subject in an AC sentence is a demonstrative or pronominal subject that is anaphoric to the trigger; and the AC sentences contain the copula as the main predicate, and the post copular phrase can be a small clause, as in (109), or something smaller, as in (110).

(110) Blind date context: *Mary is meeting John for a blind date and he has indicated that he will be wearing a red scarf. Mary sees a man in a red scarf and says:*

- a. That will be John.
- b. #He will be John.
- c. #You will be John.

(111) *Blind date context*

- a. That must be John.
- b. He must be John.
- c. You must be John.

The prejacent *that be John* can felicitously occur with either *must* or *will* in this context. In contrast, the prejacent *you are John* and *he is John* can only felicitously occur with *must* and cannot occur with *will* in this context. This is parallel to the contrast between (109b) and the *that* sentence in (109a).

This chapter shows that the data in (109) conform to the empirical generalizations put forth for present-tense (PT) *will* in Chapter 2. The inference that leads to a conclusion of an AC sentence is non-abductive, while the inference that leads to the NA counterparts is abductive. Most intriguing about the comparison between the AC and the NA counterparts is that AC sentences entail their NA counterparts, yet the AC sentence is felicitous with *will*, but the NA counterpart is not.

The chapter proceeds as follows: Section 3.1 discusses the semantics of the AC sentences. Section 3.2 shows that the inferences are in fact non-abductive, using the tests from Chapter 2. Section 3.3 shows that the contrast between the AC sentences and their NA counterparts can be replicated cross-linguistically with future markers that have been co-opted for present inference.

## 3.1 Semantics of the Anaphoric Construction

This section discusses the semantics of unmodalized sentences featuring the Anaphoric Construction (AC), such as those in (112).

- (112) a. That is the neighbors barbecuing.  
b. That is the cookies burning.  
c. That is John in the attic.

After discussing the semantics of the unmodalized forms, Section 3.1.3 returns to the AC sentences with *will*.

### 3.1.1 Demonstrative subject

There is clear evidence that the subject of the AC sentences are not expletive and are in fact anaphoric to the trigger. AC sentences are only felicitous in contexts where a referent is available for *that*. For example, (113a)-(113b) are infelicitous in the Friday night barbecue context.

- (113) Friday night barbecue: Your neighbors have barbecues on Friday nights. It is Friday night and you are out of town, you say:  
a. #That must be the neighbors barbecuing.  
b. #That will be the neighbors barbecuing.

Additionally, *that* can be replaced with *this*, depending on the speaker's proximity to the eventuality, or *it*, if the referent is mentioned linguistically. Its referent can also be constrained with gesturing. These properties are shown in (114).

- (114) *Context: There is a loud banging sound coming from upstairs and music blasting from the backyard.*

- a. This (*pointing to backyard*) will be my brother blasting his music, and that (*pointing up*) will be the neighbors remodeling.
- b. This (*pointing to backyard*) must be my brother blasting his music, and that (*pointing up*) must be the neighbors remodeling.

Given that the subjects are not expletive, the question becomes: What do they refer to? They seem to behave similarly to demonstrative and pronominal subjects with post copular DPs, as discussed by Mikkelsen (2004), Heller and Wolter (2008), Moltmann (2013) and exemplified in (115).

- (115)
- a. *This* is Rosa.
  - b. *That's* a woman.
  - c. A woman walked in. *It* was Rosa.

These pronouns have been called *presentational pronouns*. Mikkelsen (2004), Heller and Wolter (2008), and Moltmann (2013) all analyze the pronouns in (115) as referring to an intermediate element, rather than the individual denoted by the post-copular DP. For example, *this* in (115a) does not refer directly to Rosa. The analyses differ from one author to another: Mikkelsen (2004) analyzes the pronouns as referring to a property, Heller and Wolter (2008) an individual concept, and Moltmann (2013) a trope. Moltmann writes: "...in some way they stand for a contextually given perceptual presentation—a feature or a collection of features given by the non-linguistic environment" (p. 54 ). All agree that the pronoun refers to some intermediary element (not the actual individual denoted by the post-copular phrase) that is contextually salient (the usual requirement for a pronoun).

The presentational pronouns share some key properties with the pronouns in AC sentences. Consider the AC sentences in (116).

- (116)
- a. *That* is the neighbors barbecuing.
  - b. *This* is John singing.
  - c. Can you hear that pounding? *It* is John in the attic.

The subjects in (115) and (116) all seem to be context dependent in the same way; they identify some element in the context. In fact, some of these forms seem to be interchangeable. Consider (116b). In a context where we are listening to a radio and John's voice comes on, both *That is John* or *That is John singing* are acceptable and seem to convey similar meanings, if not the same meaning.

It is likely that the subjects of AC sentences are presentational pronouns. The presentational pronouns in (115) are easily identified because *that, this*, and *it* generally cannot refer to humans, and the post-copular DP refers to a human. This makes it immediately apparent that the pronouns do not refer to the individual denoted by post-copular DP. It is less clear whether pronouns are presentational pronouns when the post-copular DP denotes a non-human individual, as in (117).

- (117) a. *This* is Spot.  
b. *That's* a dog.  
c. A dog walked in. *It* was Spot.

Similarly, with ACs, it isn't clear that these pronouns cannot directly refer to the element denoted by the post-copular small clause—the topic of the next section.

There is evidence—albeit weak—that the referent of the demonstrative (*this* or *that*) is an eventuality. When the demonstrative occurs with a noun, the *-ing* nominalization is preferred, although it is degraded compared to the bare demonstrative. This is shown in (118).

- (118) *It's noon. Your postman always knocks on the door around this time of the day. You hear a knock.*
- a. That is the postman at the door.  
b. ?That knocking is the postman at the door.  
c. #That knock is the postman at the door.



Grimshaw (1990) shows that these nominalizations are necessarily eventive. Given this, I will assume that these pronouns refer to an eventuality corresponding to the contextually salient perception, i.e., a sight or a smell.

(119) REFERENT OF AC SUBJECTS

- a. *that* refers to an eventuality *e* that is contextually salient and distal
- b. *this* refers to an eventuality *e* that is contextually salient and proximal
- c. *it* refers to an eventuality *e* that has been linguistically mentioned

Nothing in this argument—especially related to *will*—hinges on this decision. I leave open the possibility that these pronouns refer to an intermediate element (e.g., a property or trope) rather than the eventuality or perception itself.

### 3.1.2 Post-copular small clause

The post-copular small clause of AC sentences can be formed with a prepositional phrase, as in (120), or with a progressive or gerund, as in (121). It cannot be formed with an adjective, as in (122).

(120) *John is in the attic fixing the insulation. You hear stomping coming from the ceiling.*

- a. That will be John in the attic.

(121) *The phone rings. Your mother always calls around this time.*

- a. That will be my mother calling.

(122) *You hear John stomping in his room.*

- a. #That will be John angry.
- b. #That will be John upset.

The meaning of the post-copular element in AC sentences is semantically similar to the complement of a perception verb, such as those in (123) and (124). In this section, I will briefly discuss the semantics of small clauses. There is a lot more to be said, especially because small clauses do not seem to be a homogenous category (cf. (121) vs. (122)).

- (123) a. John saw [the neighbors barbecuing].  
 b. That is [the neighbors barbecuing].

- (124) a. Mary heard [John making coffee].  
 b. That is [John making coffee].

Barwise (1981) analyses the complement of a perception verb as denoting a situation or scene that supports the small clause. For example, consider the sentence in (125). Barwise (1981) analyzes the small clause as denoting a scene, a visually perceived situation.

- (125) Angela saw Mark dancing.  
 a.  $\exists s[a \text{ SEE } s \wedge s \epsilon \llbracket \text{Mark dancing} \rrbracket]$

(125) asserts that there is a scene or situation that supports the small clause *mark dancing* and that Mary stands in a seeing relation with that scene. Barwise (1981) gives the following frames for bounded quantification over situations.

- (126) a.  $\forall s[a P s \rightarrow \dots]$   
 b.  $\exists s[a P s \wedge \dots]$  (p. 396)

In (126), *P* is a predicate that directly relates *a* to a situation. In the context of the perception verbs discussed in (123)-(124), *P* would be a perception verb relating the subject with a situation that supports ( $\epsilon$ ) the small clause. While Barwise uses the term *situation*, I will instead use *eventuality*. The definition for a small clause adapted from Barwise (1981) is given below in (127).

(127) A small clause  $\phi$  denotes an eventuality  $e$  such that  $e$  supports ( $\epsilon$ )  $\phi$ .

I will assume that the small clause introduces a variable over eventualities and that it is later bound by a default existential quantifier.

Which eventualities “support”  $\phi$  (a small clause) is not immediately apparent. For example, consider the small clauses in (128). The small clause *Chris in the attic* is not only supported by an event of Chris actually being in the attic, but also by an event of stomping noises coming from the attic. That is, (128a) is true if Ruth just heard stomping coming from the attic.

- (128) a. Ruth heard [<sub>SC</sub> Chris in the attic].  
b. Terra smelt [<sub>SC</sub> the brownies burning].  
c. Londen saw [<sub>SC</sub> the pizza baking].

The sentence in (128b) is true in a context where Terra’s perception is a smoky smell—a result of the brownies burning. In (128c), most likely the perceived eventuality is the baking itself; Londen is likely looking at the pizza in the oven. This suggests that a small clause can denote an eventuality that is a result state of the eventuality described by the small clause. With perception verbs, whether the small clause denotes the result or actual event depends on the verb.

So far, we have seen that small clauses can refer to the eventuality denoted by the small clause or its result state. It cannot, however, refer to the cause. For example, (129a) is not true if John saw rain falling, which eventually did lead to flooding. Likewise, (129b) is not true if John just heard the rain falling. (129a) and (129b) are true if John sees/hears the actual flooding or a result of the flooding.

- (129) a. John saw [the streets flooding].  
b. John heard [the streets flooding].  
c. John saw [Mary angry].

The sentence in (129c), in contrast, is false if John saw an eventuality that causes Mary to get angry—for example, if he saw Peter disrespect her. In order for (129c) to be true, John would have to see Mary stomping with rage or be in the process of getting angry.

In sum, small clauses seem to be able to refer to the eventuality denoted by the small clause or the result state of that eventuality, but they cannot refer to the cause. Rather than modify the definition for a small clause in (127), this can be stated as a generalization about what it means for an eventuality to support a small clause, as in (130).

- (130) An eventuality  $e$  supports  $(\epsilon) \phi$  iff
- a.  $e$  is an instance of  $\phi$ , or
  - b.  $e$  is a result state of an eventuality  $e'$  s.t.  $e'$  is an instance of  $\phi$

I encode this fact as a description of what it means for an eventuality to support  $\phi$  because it isn't unique to small clauses that they can refer to the “actual event” or the result state. This variability can be found in other event denoting elements as well.

This ambiguity can be found with nominalizations as well. (131) is true iff John saw the process of the destroying or the result of the destroying—maybe the crumbled buildings. But (131) is false if he saw the bomb fall (the cause) but covered his eyes before the destruction occurred (the process or result).

- (131) John saw the destruction.

In sum, both nominalizations and small clauses refer to eventualities. Both allow for a process/actual event or result reading, but neither can have a cause reading. This may reflect something general about how people view events rather than a fact about the semantics of a particular construction. Result states are viewed as part of the eventuality, but a cause is not.<sup>1</sup>

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<sup>1</sup>Note that a result state only supports a small clause or nominalization if it is a “direct result” of the eventuality. (129a) is false if John sees the damage caused by flooding years ago. Likewise, (131) is false if John sees families leaving the city—an indirect result of the city's being destroyed. I leave this as an open question, and only discuss cases in which the result states seem to be “direct results” of the eventuality.

### 3.1.3 Returning to AC sentences

The AC sentences replicate the findings with perception verbs in the previous section. In this construction, the small clause can refer to either the actual event or the result state, but it cannot refer to the cause. In the smoky barbecue context, the perceived eventuality is the smoky smell. In (132), both of the small clauses seem to be able to pick out the result state of the neighbors' barbecuing.

- (132) Smoky barbecue: Angela knows that her neighbors barbecue often. A friend is over at her house and they both smell something smoky. Angela says:
- a. That is [the neighbors barbecuing].
  - b. I can smell [the neighbors barbecuing].

The small clause can also pick out the eventuality itself. The AC sentence in (133a) is true when the eventualities are in fact identical, as is set up in the context in (133). In this context, the speaker points to the actual event of the neighbors' barbecuing and says (133a). In doing this, the speaker shows the addressee what an event of barbecuing is.

- (133) Dowager explaining barbecue: Adam has a guest that doesn't know what a barbecue is, the Dowager Countess of Grantham. She has been talking to the neighbors and tells Adam that they said they are doing something called "barbecuing." Adam walks her over to the window and outside you can see the neighbors with their grill going. Adam says:
- a. That is [the neighbors barbecuing].
  - b. Out the window, you can see [the neighbors barbecuing].

The perception associated with the demonstrative does not have to be strictly the same as the eventuality denoted by the small clause. Even in their unmodalized form, the AC sentences are compatible with only some relations between the two events. As discussed for small clause complements of perception verbs and nominalizations, the post-copular small clause cannot

refer to a cause. Specifically, (134) *can* have an interpretation like (134a), but it cannot have one like (134b).

- (134) That is the neighbors barbecuing.
- a. → That is (the result of) the neighbors barbecuing.
  - b. → That is (the cause of) the neighbors barbecuing.

The relevant observation is that (134) can also be uttered in a context where the demonstrative picks out a *result* of the small clause but not in a context where it picks out the *cause*. This is unsurprising if the small clause can refer to the result state but not the cause of the eventuality described by the small clause.

Evidence of this asymmetry can be found in contexts where the causation is varied, as in (135) and (136). In (135), the bell ringing causes the students to leave. In this context, a speaker cannot say *that (ringing) is the students leaving*. In contrast, the causation is flipped in (136). In this context, the bell is the result of the children leaving, and now a speaker can say *that (ringing) is the children leaving*.

- (135) *Context: The students are allowed on brakes at random intervals. When the bell rings the students leave the classroom and play. The bell rings.*  
#That's the students leaving.

- (136) *Context: (weird world) When students leave the classroom, a bell rings to warn people that there are loose children in the hallways. The bell rings.*  
That's the students leaving.

The generalization that can be drawn from the data above is that the small clause can refer to result of the students leaving but not the cause of the students leaving. (135) is infelicitous because the eventuality picked out by *that* (the bell's ringing) is the cause of the eventuality of the small clause (the students' leaving). In contrast, in (136) both the demonstrative and the

small clause pick out the same eventuality: the result of the students leaving. This is expected under the definition for support of an eventuality given in (130).

### 3.1.4 Putting the parts together

So far, we have determined the following: (i) The demonstrative subject refers to a contextually salient eventuality. (ii) The post-copular small clause  $\phi$  picks out an eventuality that supports  $\phi$ , either an eventuality of  $\phi$  or an eventuality that is a (direct) result of  $\phi$ . Given that both the pre- and post-copular elements refer to individuals of the same type, these sentences are simple identificational sentences. The copula can be given the simple identity semantics of Partee (1987), as in (137).

(137) IDENT :=  $\lambda y \lambda x [x = y]$

In the ACs, the eventuality referred to by the demonstrative is identified with the eventuality of the small clause. Because the small clause can optionally refer to a result state—a state that is caused by the actual eventuality denoted by the small clause—a sentence of the form (138a) allows for the meaning in (138b).

(138) a. That is [small clause].  
b. That is (*caused by*) [small clause].

For example, if we return to the smoky barbecue context, the sentence in (139a) can have an interpretation as in (139b).

(139) *Smoky barbecue context*  
a. That is the neighbors barbecuing.  
b. That is (*caused by/the result of*) the neighbors barbecuing.

The semantics of (139a) is given below.

$$(140) \quad \llbracket (139a) \rrbracket^{w,c,g} = 1 \text{ iff } \exists e[e = g(e_4) \wedge e \in \llbracket \text{the neighbors be barbecuing} \rrbracket^{w,c,g}]$$

The demonstrative refers to a contextually salient eventuality (type  $\nu$ ). The demonstrative denotes a variable with an index, and the value of the index is provided by the assignment function. In the smoky barbecue context, the demonstrative refers to an eventuality which is the state of there being smoke in the air. The small clause also refers to an eventuality (type  $\nu$ ); it refers to the result state of an eventuality that is an eventuality of the neighbors barbecuing. Notice that the small clause could potentially refer to an eventuality of the neighbors' barbecuing, but in this context it does not. Both the pre- and post-copular elements refer to eventualities, and the copular equates the two. In sum, (139a) is true as long as there is an eventuality of the neighbors barbecuing and it is identified with the contextually salient smoke.

The meaning in (138b) is similar to the abductive inferences discussed in Chapter 2. It equates the eventuality of the demonstrative with its cause: the eventuality of the small clause. I will return to this point in Section 3.2.

In sum, this section has discussed the semantics of sentences with the form (141). The pre- and post-copular phrases both denote eventualities. The copula co-identifies these two eventualities.

$$(141) \quad \text{That is [small clause]}$$

Section 3.1.2 showed that strict identity is not required for these sentences. The eventuality picked out by the demonstrative can be a result state of the eventuality denoted by the small clause. In these cases, where there isn't strict identity, the AC sentences make an abductive claim: that the eventuality denoted by the demonstrative is caused by the eventuality of the small clause. This will be discussed further in the next section.



### 3.2 AC sentences involve non-abductive inferences

This section compares the inferences involved when the conclusions are AC sentences (the (a) sentences in (142)-(144)) with those inferences involved when the conclusions are their NA counterparts. The underlying question is why the AC sentences are felicitous with *will* but the NA sentences are not.

(142) *John is in the attic fixing the insulation. You hear stomping coming from the ceiling.*

- a. That will be John in the attic.
- b. #John will be in the attic.

(143) *The phone rings. Your mother always calls around this time.*

- a. That will be my mother calling.
- b. #My mother will be calling.

(144) *Smoky barbecue context*

- a. That will be the neighbors barbecuing.
- b. #The neighbors will be barbecuing.

I will show that the inference involved when the conclusion is an AC sentence is importantly different from the inference involved when the conclusion is its NA counterpart. Reaching the AC conclusions involves a non-abductive inference, while reaching their NA counterparts involves an abductive one. Given this, since *will* is incompatible with abductive inferences, it is expected that *will* is acceptable with the AC sentences but not with their NA counterparts. Note that *must* is felicitous in both the AC sentences and their NA counterparts. I will first explain why the inferences are different and then provide the tests that demonstrate the difference.

In all of the contexts in (142)-(144), there is both a perceptual trigger (*phone ringing, stomping, or smoky smell*) and a belief about what is causing that observation (*John is fixing*

*something, Mom always calls now, or The neighbors regularly barbecue*). I will use the familiar smoky barbecue context, schematized in (145), to show the difference in inferences.

- (145) Aspects of smoky barbecue context:
- a. perceptual trigger: *There is smoke*
  - b. belief about cause: *The neighbors regularly barbecue*

In the following discussion, it will be useful to refer both to the prejacent (embedded proposition) and to the conclusion associated with that proposition. These are given below.

- (146) a. *prejacent: the neighbors be barbecuing*  
conclusion: the neighbors are barbecuing
- b. *prejacent: that be the neighbors barbecuing*  
conclusion: that is the neighbors barbecuing.

In determining whether an inference is abductive or non-abductive, we need to consider how the trigger event is related to the eventuality of the conclusion in (146). The relation between the observation and (146a) was discussed extensively in Chapter 2. Reiterating briefly, to conclude (146a) in the smoky barbecue context, the speaker needs to put together two pieces of information: (145a) that there is a smoky smell and (145b) that the neighbors regularly barbecue. The inference is abductive because the speaker observes the smell (145a) and uses the neighbors' habits (145b) to conclude that the neighbors are barbecuing (146a). Thus the inference is from an observation (145a) to its cause (146a); the neighbors' barbecuing explains why there is smoke. This is a canonical abductive inference.

It is less straightforward to determine the inference pattern that leads to the conclusion in (146b). This is because the meaning of the prejacent is less transparent. As discussed in Section 3.1.2, the AC sentence is itself abductive in a way. It is an identity statement about two eventualities: the trigger (the smokiness (145a)) and the eventuality associated with the conclusion from the NA counterparts (146a). It relates a result state and a cause. The relevant

factor for the acceptability of *will*, however, is if concluding (146b) in this context (from the trigger) is an abductive inference. That is, is the inference from the smell to the conclusion that the smell is caused by the neighbors' barbecuing an inference from a result to its cause? The answer is no. The fact that the smoke is (caused by) the neighbors' barbecuing does not directly explain why there is smoke.

The inference patterns with (146b) and (146a) are summarized in the chart below.

Figure 3.1: Summary of inferences that lead to AC and NA counterparts

	trigger	conclusion
(146b)	there is smoke	the smoke is (caused by) the neighbors' barbecuing (not the cause of observation)
(146a)	there is smoke	the neighbors are barbecuing (cause of observation)

All of the pairs of sentences in (142)-(145) exhibit the same pattern: the AC sentences (with *that*, (a)) are felicitous because the conclusion of the prejacent is arrived at using non-abductive reasoning, and their NA counterparts (the (b) sentences, without *that*) are infelicitous because the conclusion is arrived at using abductive reasoning. The difference is subtle because the AC sentences still contain an abductive component, but that component is contained in the conclusion (prejacent) rather than the speaker inference marked by *will*. This makes it possible for the AC sentences to avoid *will's* restriction on abductive reasoning and to express a meaning similar to their NA counterparts by encoding the abduction in the prejacent itself.

### 3.2.1 Tests for type of inference

This section presents the tests used in Chapter 2 to show that the inferences involved with an AC conclusion are non-abductive, whereas those involved with their NA counterparts are abductive.

**Apparently** The first test is whether the unmodalized form of the sentence can occur with *apparently* in the context. This is based on Krawczyk's (2012) claim that *apparently* requires an abductive inference. Recall (147): the conclusion *the neighbors are barbecuing* can occur with *apparently* in the smoky barbecue context.

(147) *Smoky barbecue context*

- a. ✓ Apparently, the neighbors are barbecuing.
- b. #The neighbors will be barbecuing.

This can be contrasted with the felicity of the AC sentences in (148). In the same smoky barbecue context, it is infelicitous for the unmodalized AC sentence to occur with *apparently*.<sup>2</sup>

(148) *Smoky barbecue context*

- a. #Apparently, that is the neighbors barbecuing.
- b. ✓ That will be the neighbors barbecuing.

The fact that the unmodalized form cannot occur with *apparently* is evidence that the inference involved is not abductive.

**Why/because** In Chapter 2 we saw that the *why/because* test could also be used to test for an abductive inference. For example, in the smoky barbecue context, *Because the neighbors are barbecuing* is an acceptable response for the question *Why is there a smoke?*. This is repeated in (149). The *why*-question contains the observation (smoke), and the *because*-answer contains the prejacent (neighbors barbecuing). This question-answer pair is coherent, and thus the inference is an abductive one.

(149) *Smoky barbecue context*

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<sup>2</sup>The only way for (148a) to be felicitous is to modify the context. In addition to its abductive use, *apparently* also has a hearsay use; note that Krawczyk (2012) claims that this use is also abductive.

- a. *Why/because test*:
  - (i) Why is there smoke?
  - (ii) ✓Because the neighbors are barbecuing.
- b. #The neighbors will be barbecuing.

This can be compared with test in which the *because* answer instead contains a AC sentence, as in (150). This question-answer pair is not coherent; that is, the *because* response is not an acceptable response to the *why*-question. This suggests that the inference from the smoke to the conclusion that the smell is the neighbors barbecuing is not an abductive one.

(150) *Smoky barbecue context*

- a. *Why/because test*:
  - (i) Why is there smoke?
  - (ii) #Because that is the neighbors barbecuing.
- b. ✓That will be the neighbors barbecuing.

Again, the felicity of the *why/because* test is in complementary distribution with *will*. These tests show that the inference that leads to the conclusion of the AC sentences is not abductive.

The AC sentences provide further support for the claim that what *will* is incompatible with is abductive reasoning. The meanings of the AC sentences and of their NA counterparts are similar, but they differ in whether they involve abductive reasoning. These sentences also rule out any analysis which is based on a notion of speaker certainty—for example, an analysis that would rule out the NA counterpart, e.g., *the neighbors will be barbecuing*, in the smoky barbecue context because the speaker isn't certain of the prejacent (maybe there is a food truck causing the smoke). This type of analysis would incorrectly predict that the AC sentence, e.g., *that will be the neighbors barbecuing*, would also be unacceptable. This is because of the entailment that holds between the AC sentences and their NA counterparts. If the speaker is uncertain that the neighbors are barbecuing, then the speaker is necessarily uncertain that the smoke is the neighbors barbecuing. This point will be discussed further in Chapter 4.

### 3.3 Replicating the English pattern in other languages

This section presents data from other languages to show that the contrast between the Anaphoric Construction (AC) and its Non-Anaphoric (NA) counterpart is not limited to English. Chapter 2 showed that there is a diversity of languages that co-opt their future tense marker for present inference, and of those languages, all obey the inferential restriction. These properties are summarized in (151a)-(151b). This section will discuss a third property in (151c): whether ACs can be used to evade the inferential restriction.

(151) **Cross-linguistic variation in future markers (part2)**

- a. *Employs future evidential-strategy*: Does the language use its future marker to express present inference?
- b. *Obeys inferential restriction*: Is the present inference interpretation only licensed in cases of non-abductive reasoning?
- c. *AC exception*: Can the evidential strategy be used in apparent abductive contexts by using ACs?

Chapter 2 discussed seven languages that employ the future evidential-strategy. The set of languages discussed in this section will be more restricted because not all languages allow for the structure of ACs.

Returning to the abductive and non-abductive contexts from Chapter 2, the ACs can be added, as in (152) and (153). In English, the AC is unacceptable in the non-abductive context (152) simply because there is no referent for *that*.

(152) *Non-abductive context*: You know your neighbors have loud dinner parties every Friday night between 6-8pm. You're out of town, but notice that it is 7pm on a Friday. You say:

- a. The neighbors will be having a party
- b. #That will be the neighbors (having a party)

- (153) *Abductive context*: You know your neighbors often have loud dinner parties. You hear music coming from their apartment and say:
- a. #The neighbors will be having a party
  - b. That will be the neighbors (having a party)

The AC sentence is acceptable in the abductive context (152), but the related form without *that* is unacceptable.

The pattern is faithfully replicated in **Spanish** and **Catalan**.<sup>3</sup> As discussed in Chapter 2, (154) and (155) are acceptable in the non-abductive context (152), but they are unacceptable in the abductive context (153).

- |       |  |         |
|-------|--|---------|
| (154) | Los vecinos estar- <b>án</b> dando una fiesta.<br>the neighbors are-fut having a party<br><i>The neighbors will be having a party.</i> | Spanish |
| (155) | Els veïns estar- <b>an</b> donant una festa.<br>the neighbors are-fut having a party<br><i>The neighbors will be having a party.</i>   | Catalan |

The corresponding ACs in (156)-(157) have the opposite distribution. These sentences are unacceptable in the non-abductive context (152), but they are acceptable in the abductive one (153).

- |       |   |         |
|-------|---|---------|
| (156) | (Eso) ser- <b>án</b> los vecinos dando una fiesta.<br>(that) is-fut the neighbors having a party<br><i>That will be the neighbors having a party.</i> | Spanish |
| (157) | (Aixó) ser- <b>án</b> els veïns donant una festa.<br>(that) be-fut the neighbors having a party<br><i>That will be the neighbors having a party.</i>  | Catalan |

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<sup>3</sup>Thanks to Victoria Mateu for the Spanish and Catalan data.

It is unsurprising that (156)-(157) are unacceptable in the non-abductive case. Just like with the English case, they are unacceptable because there is no referent available for the demonstrative. The more interesting case is the difference in acceptability between (154)-(155) and (156)-(157) within the abductive contexts. This pattern perfectly mirrors the English data discussed in this chapter. The ACs are used to express an abductive inference.

In **Turkish**, (158) is unacceptable if the speaker hears John stomping on the roof, but the AC (159) is acceptable.

- |       |  |         |
|-------|--|---------|
| (158) | Can gati-da kalis- <b>acak</b><br>John roof-loc work-fut<br><i>John will be working on the roof.</i> | Turkish |
| (159) | (Bu) Can ol- <b>acak</b><br>(this) John be-fut<br><i>This will be John.</i>                          | Turkish |

This again means that Turkish shows the same pattern as English; the future tense marker *acak* can be used to mark present inference, but only if the inference is non-abductive (shown in Chapter 2). It can be used in an abductive context when it occurs in a AC.

The **German** future marker *werden* cannot be used to mark an abductive inference. Consider the following abductive contexts: Your neighbors often have violent arguments and they shout so loudly that you can hear them through the walls of your apartment. One day some friends are visiting, when you all hear shouting through the walls. Your friends look surprised. In this context, (160) is acceptable, but (161) is not.

- |       |   |        |
|-------|---|--------|
| (160) | Das <b>werden</b> die Nachbarn sein, die streiten immer.<br>That will(3pl) the neighbors be, they fight always<br><i>That will be the neighbors, they always fight.</i> | German |
| (161) | #Die Nachbarn <b>werden</b> streiten.<br>The neighbors will.3pl argue(inf)<br><i>The neighbors will be arguing.</i>   | German |



This data shows that the English pattern is also replicated in German: *werden* can be used to mark present inference, but only for inferences derived by non-abductive reasoning, unless an AC sentence is used.

### 3.4 Summary

This chapter discussed the Anaphoric Construction (AC) and argued that it can be used to circumvent the restriction against using *will* with abductive inferences. A comparison of the AC sentences and their non-anaphoric (NA) counterparts supports the claim that what *will* is sensitive to is abductive inferences. The linguistic tests (*apparently* and *why/because* tests) show that the difference between the AC sentences and their NA counterparts is that the latter involve an abductive inference, but the former do not. The asymmetry in acceptability with *will* is surprising given that AC sentences *entail* their NA counterparts, yet *will* is only acceptable with the AC sentences. Moreover, this contrast between the AC sentences and their NA counterparts is found in other languages as well.

## CHAPTER 4

### Accounting for the inferential restriction

Chapter 2 showed that present-tense (PT) *will* is only licensed when the speaker has inferred the prejacent from non-abductive reasoning. It also showed that this is not an accidental property of English *will*; instead, this licensing condition is found in present-tense uses of future markers in various languages. Chapter 3 provided additional support for these claims by comparing the Anaphoric Construction (AC) *that be the neighbors barbecuing* with its Non-Anaphoric (NA) counterpart *the neighbors be barbecuing*. This contrast highlights the fact that what is relevant to the licensing of PT *will* is the relation between the trigger and the conclusion (i.e., the prejacent). Moreover, epistemic *must* shows neither the inferential restriction (Chapter 2) nor the contrast between the AC sentences and their NA counterparts (Chapter 3).

This chapter shows how current theories fail to account for these facts. Section 4.1 discusses why the temporal properties of *will* (i.e., the fact that its also used as a future tense marker) can't be leveraged to derive the inferential restriction (incompatibility with abductive reasoning). Section 4.2 discusses previous theories of *evidential epistemics* (epistemic modals that encode evidential requirements) and shows that these approaches cannot be extended to account for the *will* facts. The downfall of these approaches is that they are designed to restrict the evidence for a conclusion, and what *will* restricts is the inference that leads to a conclusion. Section (288) discusses theoretical desiderata for any analysis of *will*.

#### 4.1 An analysis based on temporal properties of *will*

In this section, I will address the question as to whether the causal facts could be derived from the temporal facts. Standard analyses posit that *will* encodes future (or non-past) time

reference, regardless of whether it also has a modal component. Temporal-only accounts have been proposed by Prior (1967) and Kissine (2008). Analyses that combine modal and temporal facts have been proposed by Enç (1996), Copley (2002), Condoravdi (2002), Werner (2006)<sup>1</sup>, and Klecha (2014),<sup>2</sup> among others. Given this, it would be ideal if the apparent inferential restriction of *will* (discussed in Chapters 2 and 3) could be accounted for by appealing to its established temporal properties rather than abduction. This section sketches the outline of what would be common to all temporal accounts. It then describes why any purely temporal analysis is insufficient to account for the observed patterns with present-tense (PT) *will*.

To begin, it is helpful to step back and consider why a temporal analysis for this data might seem desirable. Abductive reasoning is also referred to as *retroductive* reasoning. There is something intuitively “back” about inferring from a result to what caused it. This is even apparent in the tense used to discuss these eventualities: a result to what caused it. This intuition is made more precise in the temporal-causal correlation below, (162).

(162)      TEMPORAL-CAUSAL CORRELATION (TCC)  
            Causes temporally precede their effects

Given this correlation, two events that are related causally will have an asymmetry both in their causation properties and in their temporal properties. This is summarized in Figure 4.1 below. The temporal and causation properties are correlated: if the observed eventuality ( $e_{ob}$ ) is the result of the eventuality of the prejacent ( $e_p$ ), then  $e_{ob}$  temporally follows  $e_p$ . If the observed eventuality ( $e_{ob}$ ) is the cause of the eventuality of the prejacent ( $e_p$ ), then  $e_{ob}$  temporally precedes  $e_p$ . (The formulation of *follows* and *precedes* will be revised shortly.) Finally, I have made the assumption that temporally related rather than causally related events

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<sup>1</sup>Condoravdi (2002) and Werner (2006) derive the future tense meaning of *will* from general principles about modal bases and temporal facts.

<sup>2</sup>See Klecha (2014) for a discussion of whether future uses of *will* should be analyzed as temporal only or also modal.

typically co-occur and thus are simultaneous. This assumption will be called into question shortly.

Figure 4.1: Temporal vs. Causal analyses

Correlations:	$e_{ob}$ is _ of $e_p$	$e_{ob}$ is _ of $e_p$	$e_{ob}$ and $e_p$
	result	cause	co-occur
	after	before	simultaneous
Data:	#will	√will	
Possible analyses:	past	non-past	
	abductive	non-abductive	

As shown in Figure 4.1, the felicity of *will* aligns with both the abductive/non-abductive distinction as well as the past/non-past distinction. This means that the generalization for the distribution of *will* could either be that (i) *will* is infelicitous when the speaker infers from a result to a cause or that (ii) *will* is infelicitous when the speaker infers from an eventuality to one that temporally precedes it. In Chapters 2 and 3, the generalization for *will* was stated in terms of inference type (i.e., abduction). According to the TCC, however, not only is the inferring-result-to-cause condition distinguished from the others by inference type (abduction), it is also distinguished by its temporal properties.

Figure 4.1 summarizes the intuition for a temporal-only account, but how could this intuition be leveraged in the semantics to account for the apparent evidential restriction on *will*? First, I will provide a sketch of what an analysis of this type would have to look like and show that the analysis is not as straight-forward as Figure 4.1 might suggest. Second, I will show that when the temporal and causal correlation is broken and the two properties are decoupled, *will* patterns with the causation property, not the temporal one.

#### 4.1.1 A sketch of a temporal analysis

In order to isolate the result-to-cause condition using solely temporal facts, there are two ways that a temporal analysis would have to diverge from a simple future-tense meaning: (i) Rather than relating the utterance time to the event time, the time of the observed eventuality would

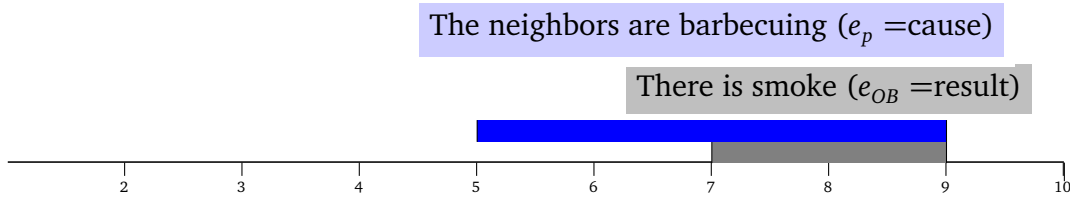
need to be related to the time of the event time (time of the eventuality of the prejacent). (ii) It would need to make reference to whether one event *starts* before the other. Thus, under a temporal analysis of the evidential requirement, the denotation of *will* would encode future, or non-past, in two respects: (a) the relation between the utterance time and the event time<sup>3</sup> and (b) the temporal relation on the inference (temporal relation between  $e_{ob}$  and  $e_p$ ).

I will use the barbecuing examples to show that these two properties are necessary for any temporal analysis that tries to derive the causation facts. To demonstrate this, I will use the timelines in (163)-(165) to depict the temporal properties of the contexts discussed in Chapter 2. The numbers on the timeline are meant to be hours.

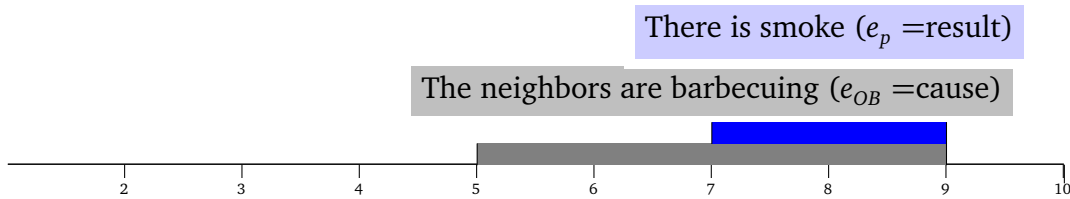
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<sup>3</sup>This relation is a property of all modals under Condoravdi's (2002) analysis.

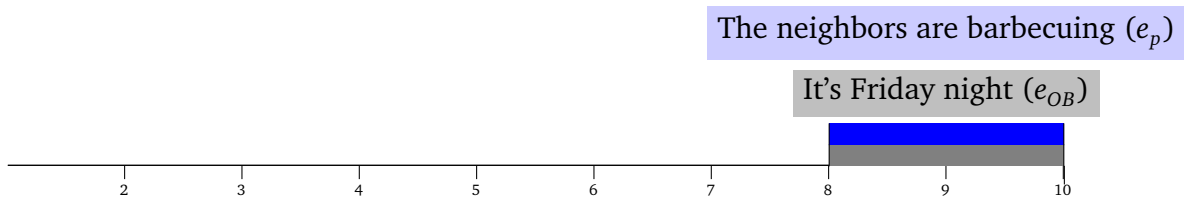
(163) Trigger: result, conclusion: cause *Smoky barbecue context*



(164) Trigger: cause, conclusion: result *Dowager Countess context*



(165) Temporally related events: *Friday night context*



The first timeline (163) represents the first condition in Figure 4.1 using the smoky barbecue context: the speaker infers from a result (smoke) to its cause (the neighbors' barbecuing). In the second timeline (164), the causal relation that holds between the eventualities is flipped: the speaker observes a cause and infers a result. In the third timeline (165), the speaker observes an eventuality and infers a simultaneous one. Recall that the goal of the temporal analysis is to distinguish the first timeline from the second two.

For all conditions, at the utterance time, the eventuality of the prejacent and the eventuality of the observation hold. For example, in the timelines above, the utterances could all occur

at 8:15pm. The difference between these three cases is not the relative temporal ordering between the utterance time and the event time (time of the eventuality of the prejacent). The difference is instead the ordering of the observed eventuality (gray) and the eventuality of the prejacent (blue/black). Given the first fact, all of these eventualities necessarily overlap; both occur at utterance time. Rather than restricting the temporal ordering of events, this approach would need to restrict the ordering of the *start time* of events. Informally, this approach would need a restriction that makes *will* infelicitous if the start-time of the observed eventuality temporally follows the start-time of the eventuality of the prejacent. This necessarily requires that the observed eventuality is represented in the semantics.

#### 4.1.2 Breaking the temporal-causation correlation

The temporal analysis would distinguish the contexts with abductive and non-abductive reasoning using the temporal-causal correlation given in (162). Thus far, the examples discussed have all obeyed these correlations. The question is: When those temporal and causal facts are decoupled, which property does *will* pattern with? I will present three pieces of evidence that when these properties are decoupled the temporal analysis makes bad predictions: *will* tracks abductive inferences, not temporal precedence.

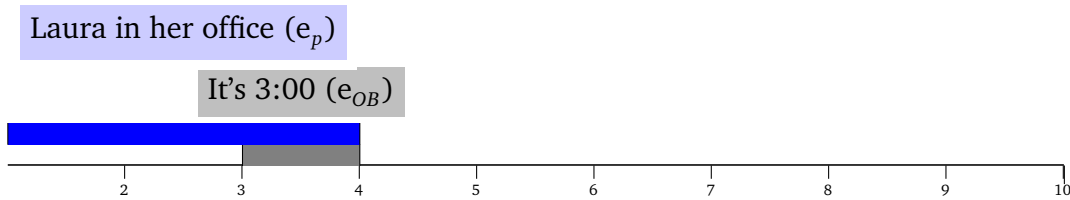
**Temporally related, but not simultaneous** The first departure from the correlations in Figure 4.1 is cases of temporally related eventualities that are not simultaneous. Consider the example below—a typical case of an inference based on a schedule and a time.

(166) *Office hours: I know that Laura has office hours at 3:00. I also know that she has been working in her office all day. Someone asks me where Laura is. It's 3:00 so I say:*

a. (It's 3:00,) Laura will be in her office. (I think she has been in there all day!)

This example is depicted in the timeline below. Laura's being in her office (eventuality of the prejacent, blue/black) occurs before it is 3:00 (observed eventuality, gray) but the use of *will* is felicitous, and the sentence in (166a) is true.

(167) *Office hours*



Note that the speaker can follow up and say *I think she has been there all day*. This shows that the speaker is aware of the possibility that the eventuality of the prejacent held before the time of the observation (it's 3:00 or it's between 3:00 and 4:00). This example, represents a general problem for a temporally based account. If I know Laura is in her office 3:00-4:00, and she happens to get there early, it doesn't change the felicity of *will*. This example shows that the eventuality of the prejacent can temporally precede the observed eventuality if they are not causally related (compare its timeline with that of (163), which is an infelicitous context for *will*).

A supporter of the temporal analysis may argue that there is a difference between the office hours example and causally related events: with causally related events, the cause *must* precede the result, whereas with the temporally related events the eventuality of the prejacent *may* precede the eventuality of the observation. Shifting from the temporal ordering of events to the *necessary* order of events is not a trivial step. The next example also shows that this change will not save the temporal analysis.

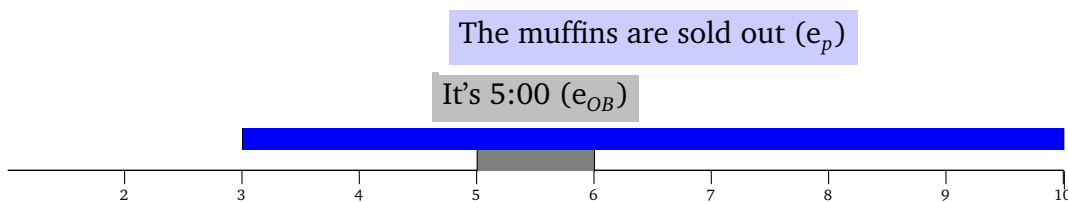
**By now adverb** Another challenge to the temporal analysis is any case where *will* felicitously occurs with the adverb *by now*. Examples of this are given below.

- (168) a. *It's Thursday*, John will be in Los Angeles by now.  
b. *It's 5:00*, The muffins will be sold out by now.  
c. *It's 5:00*, The muffins will be sold out by now, they are always gone by 3:00.



In (168b), the speaker observes that it is 5:00 and that the muffins sold out at some time before 5:00. This is depicted in the timeline below.

(169) *Muffins context*



The adverb *by now* requires that the eventuality of the prejacent necessarily precedes the utterance time. If the speaker's observation is that it is 5:00 at the utterance time, then the time of the eventuality of the observation coincides with the utterance time. Therefore, the *by now* adverb requires (indirectly) that there is a time of the eventuality of prejacent that necessarily occurs before the timespan of the eventuality of the observation. Moreover, the speaker can continue with *they are always sold out by 3:00*, making clear that the speaker is aware of the fact that the eventuality of the prejacent holds before the eventuality of the observation.

Sentences with a *by now* adverb are cases where the start of the eventuality of the prejacent necessarily precedes the eventuality of the observation, as is the case when the observation is a result and the prejacent is a cause. This shows that requiring that the eventuality of the prejacent necessarily precedes the eventuality of the observation will not distinguish the inference-from-result-to-cause condition.

**Result states already in place** The final challenge for the temporal analysis is cases where the result state holds before the cause, possibly for independent reasons. Because the result state is already in place for an independent reason, this is less obviously a challenge to the analysis. It isn't clear that the eventuality should be considered a result if it occurs for an independent reason. In these contexts, however, *will* is still judged as felicitous, so I will discuss them briefly.

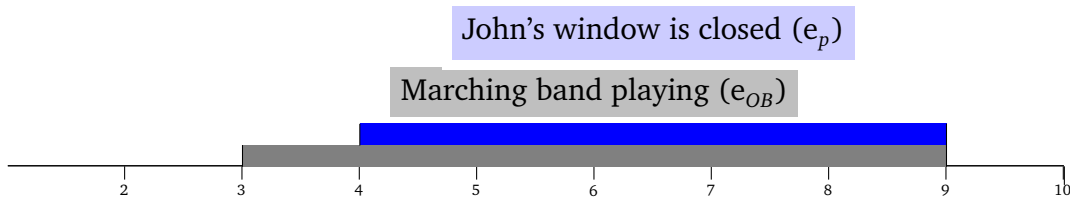
In (170), the marching band playing generally causes John to close his window.

(170) *Marching band context: You know John hates the sound of the marching band and closes his window if they are ever practicing on the football field. We hear the band playing and you say:*

- a. John's window will be closed.
- b. John's windows will be closed right now, if they weren't already closed.

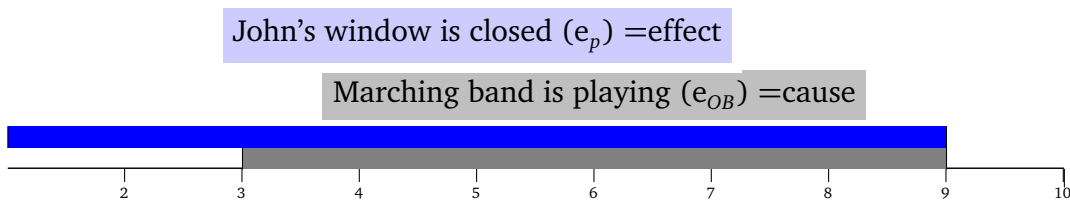
This example could occur in a larger context where John closed his window after hearing the band starting up; that is, the observed eventuality does in fact precede the eventuality of the prejacent. This is the expected case, obeying the correlations.

(171) *Marching band context*



The relevant factor is that (170a) could also occur in a larger context where John has had his window closed all day, and he was just happy it was already closed when he heard the faint sound of the band starting up, as depicted in the timeline below.

(172) *Marching band larger context:*



In both of these larger contexts, (170a) is felicitous and judged to be true. This is not predicted by the temporal analysis. The temporal properties of larger context (2) and the barbecuing example in (163) are identical, but *will* is felicitous in the marching band example but not in (163).

### 4.1.3 Interim summary

This section discussed one property of abductive inferences that could potentially be leveraged to derive the inferential restriction of *will*. It showed that the restriction can't be derived from the correlation between temporal properties of causation—from the intuitively *retroductive* nature of abductive inferences. When the temporal and causal properties are decoupled, the felicity of *will* patterns with the causal rather than temporal facts. Given that the abductive restriction cannot be derived, the semantics of *will* must directly encode some notion of abduction (i.e., causation or explanation). In the next section, I will show why current theories of how evidential facts are encoded in epistemic modals cannot easily be extended to account for the inferential restriction of *will*.

## 4.2 Inference and evidence with epistemic modality

Given that the restriction of *will* cannot be derived from the temporal facts, how then should the incompatibility of *will* with abductive inferences be encoded in the semantics? This section discusses the difficulty of incorporating this restriction with current theories of epistemic modality. Section 4.2.1 discusses how the restriction on *will* is different from typical evidential meaning. Evidentials are generally analyzed as restricting the type evidence, whereas *will* restricts the relation that holds between the evidence and the prejacent. This section discusses two approaches to encoding evidential meaning in epistemic modals: restricting the worlds in the modal base (Matthewson et al. 2007, Matthewson 2015) and structuring the modal base (von Stechow and Gillies 2010). Section 4.2.2 will discuss evidential relations—a different approach for analyzing evidential meaning proposed by Krawczyk (2012).

The discussion of how the restriction on *will* should be integrated into the semantics of epistemic modality touches on a more fundamental need to better understand how inferences are represented in the semantics and how different types of inferences differ from each other. Without a better understanding of how natural language encodes different inference types, it is difficult to evaluate what a particular analysis of *will* or *must* might predict. Certainly if both modals receive the same analysis—for example if both are analyzed as universal (ungraded) epistemic modals—then no difference between the two is predicted. It is possible, however, that within a framework that gives an explicit semantics of different inference types, some independent difference between *will* and *must* could be leveraged to account for the difference in compatibility with abductive reasoning. Providing such a framework is outside of the scope of this dissertation. For this reason, I will discuss theoretical desiderata in Section 4.3, but I will leave a complete analysis for future work.

#### 4.2.1 Previous analyses of evidence and epistemic modality

It is well known that epistemic modals can restrict the type of evidence a speaker has for the prejacent. Karttunen (1972) first pointed out that the use of *must* requires the speaker to have inferred the truth of the prejacent. This is shown below in examples (173)-(174) taken from von Stechow and Gillies (2010), vF&G.

(173) *Context: Seeing the pouring rain.*

a. It's raining.

b. ??It must be raining. =vF&G (6)

(174) *Context: Seeing wet rain gear and knowing rain is the only possible cause.*

a. It's raining.

b. It must be raining. =vF&G (7)

In (173), the speaker has directly perceived the rain, and the use of *must* is unacceptable. In (174), the speaker has not directly perceived rain; she instead sees a result of the rain. Thus,

the use of *must* is compatible with the speaker having indirect, but not direct, evidence for the prejacent. vF&G take the contrast between (173) and (174) to indicate that *must* carries an evidential component—namely, that the truth of the prejacent was inferred rather than directly perceived or learned through a trustworthy report.

As discussed in Chapter 1, *must* is not the only lexical item that has been analyzed as an epistemic modal that encodes information about evidence. In fact, it has been claimed that all epistemic modals encode information about evidence (von Fintel and Gillies 2010, Matthewson 2015). In this section, I will briefly discuss two approaches for encoding evidential restrictions for epistemic modals and will discuss why they are not ideal for accounting for the inferential restriction on *will*. This is because these analyses are designed to encode information about the evidence and *will*'s restriction is inherently relational.

#### 4.2.1.1 Restricting worlds in the modal base

Matthewson et al. (2007), Matthewson (2015) analyze epistemic modals as having an evidential presupposition on their modal base, as schematized in (175), (modeled after Matthewson et al. (2007), (76), pg. 56).<sup>4</sup>

(175)  $\llbracket \text{MODAL } \varphi \rrbracket^{w,f}$  is only defined if for all worlds  $w'$ ,  $w' \in f(w)$  iff the EVIDENCE for  $\varphi$  in  $w$  holds in  $w'$

The presupposition in (175) states that the modal base contains only worlds that are compatible with a particular type of evidence. For example, if the epistemic modal required hearsay evidence, the modal base would be *all worlds compatible with what the speaker heard* or specifically *all worlds where Mary said John is the murderer*.<sup>5</sup> The denotation also presupposes that

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<sup>4</sup>I ignore the choice function aspect of the analysis because it is used to derive variable force—something that will not be relevant to the discussion of *will* and *must*. Although see Chapter 6 for a discussion of variable force analyses of future tense markers by Rivero (2014), Rivero and Simeonova (2014), Mihoc (2012).

<sup>5</sup>Kratzer (2012) points out that with hearsay evidentials the modal base might be constrained by the *information* of the speech act or by the *presence* of the speech act.

that type of evidence exists in  $w$ . Thus, the presupposition in (175) carries two parts: (i) that the speaker has a particular type of evidence for the prejacent in the actual world and (ii) that the worlds in the modal base are all and only the ones compatible with that evidence. According to Matthewson (2015), epistemic modals may differ in the type of evidence they require, but what is common to all epistemic modals is that they require some type of evidence.

#### 4.2.1.2 Structured modal bases

vF&G claim that the requirement for indirect evidence is not unique to *must* but is instead present for all epistemic modals. They claim that they have not found a language in which epistemic modals do not signal that the speaker has inferred the truth of the prejacent. For this reason—rather than stipulating a requirement for indirect evidence, as is typically done for evidential markers—vF&G strive to give an analysis in which the indirect requirement follows naturally from the meaning of epistemic modality. They propose a theory of structured (epistemic) modal bases. They write:

“Our proposal is that not all information that our modals quantify over is created equal: some of it is privileged information. So we also need, in addition to modal bases, kernels. These represent what information is direct information in the context—or direct enough in the context, since what counts as direct may well depend on context.” (p. 371)

These modal bases distinguish between privileged propositions (those in the kernel) and those inferable from the privileged information (a modal base projected from the kernel).

They characterize the set of privileged propositions as propositions the speaker has direct or trustworthy evidence for. The definition of a kernel is given in (176).

(176)  $K$  is a kernel for  $B_K$ ,  $B_K$  is determined by the kernel  $K$ , only if:

a.  $K$  is a set of propositions (if  $P \in K$  then  $P \subseteq W$ )

b.  $B_K = \bigcap K$

vF&G Kernels and bases

*Must- $\varphi$*  asserts that  $\varphi$  is compatible the information inferable from  $K$  but is not in the kernel itself. The denotation for *must* is given in (177).

(177) (Strong *must* + evidentiality). Fix a  $c$ -relevant kernel  $K$ :

- a.  $\llbracket \textit{must } \varphi \rrbracket^{c,w}$  is defined only if  $K$  does not directly settle  $\llbracket \varphi \rrbracket^c$
- b. If defined,  $\llbracket \textit{must } \varphi \rrbracket^{c,w} = 1$  iff  $B_K \subseteq \llbracket \varphi \rrbracket^c$  vF&G (p.372)

Rather than requiring indirect evidence, or an inference, the evidential component is derived from a ban on direct evidence through a settledness requirement. The presupposition requires that the direct evidence not settle the issue of the prejacent, but the assertion requires that all worlds compatible with the kernel are worlds in which the prejacent is true. A kernel  $K$  directly settles  $P$  if there is a single proposition in  $K$  that either entails or contradicts  $P$ , as in (178).

(178)  $K$  directly settles whether  $P$  iff either  $X \subseteq P$  or  $X \cap P = \emptyset$  for some  $X \in K$  vF&G (p.374)

Together, the asserted and presupposed content require that there are at least two propositions that together entail the prejacent. There isn't a proposition in the kernel that alone contradicts or entails the prejacent. Thus, the indirectness requirement is derived.

vF&G's structured modal bases have also been used to account for epistemic modals that have evidential requirements that are more fine-grained than simply requiring indirect evidence. Matthewson (2010) proposes that the St'át'imcets evidential *lákw7a* presupposes which subsets of the kernel provides information about the prejacent.

(179)  $\llbracket \textit{lákw7a } \varphi \rrbracket^{c,w}$  is defined only if:

- a.  $K_{SENS}$  contains information which bears on  $\varphi$
- b.  $K_{VIS}$  [the set of propositions obtained through vision] does not directly settle  $\varphi$

The sets  $K_{SENS}$  and  $K_{VIS}$  are kernels that have been specified to contain certain propositions: those learned through a specific perception. Thus, structured modal bases can be used to model epistemic evidentials that encode evidential meanings beyond the ban on direct evidence. It isn't clear, however, that restricting the kernel in this way is any less stipulative than restricting the worlds in the modal base, as discussed in the previous section. This defeats the goal of vF&G to derive the evidential component of epistemic modals. Matthewson (2015) argues, however, that epistemic modals are not uniform in their evidential contributions.

#### 4.2.1.3 Extending evidential accounts to *will*

Under both approaches discussed above, modals put a restriction on the evidence the speaker has for a proposition  $p$  in order for the modal to be used felicitously. For example, the restriction might require that the speaker learned  $p$  through hearsay or by visual perception, or more broadly, that propositions learned through direct perception and trustworthy reports cannot settle the issue of  $p$ . These are all phrased as restrictions on the evidence for a proposition.

I have described *will*'s incompatibility with abductive inferences as an *inferential* restriction rather than an *evidential* one. This is because *will* does not restrict an intrinsic aspect of the evidence itself, but instead it restricts how the evidence relates to the prejacent (the inference). *Will* is not unique in this respect. Categories like indirect and direct are also restrictions on the relation between the evidence and the prejacent; it is not an intrinsic property of the evidence that it is indirect. Instead, evidence is considered indirect relative to the prejacent. For example, seeing wet umbrellas is considered indirect evidence for the proposition *it is raining* but direct evidence for the proposition *there are wet umbrellas*. Thus, the requirement for indirect evidence actually restricts the relation that holds between the evidence and the prejacent, but this is not represented in the semantics. The term "indirect evidence" obscures this fact.

In vF&G's structured modal bases, the inference only comes about as an entailment of the assertion and presupposition. There is a distinction between the kernel (i.e., directly known propositions) and the worlds compatible with the kernel. The requirement for an inference



only arises indirectly from the fact that the prejacent is presupposed to not be settled by the kernel but entailed by it. Because the inference is not represented in the semantics, it cannot easily be manipulated to require that the inference be non-abductive.

At first glance, the difference between *will* and *must* seems to be analogous to a distinction found in the evidentiality literature between ‘assumed’ and ‘inferred’ evidentials. Aikhenvald’s (2004) descriptions of these categories appear in (180) below. Note that the *INFERRED* category has also been called ‘inference from results’ (Willett 1988) and ‘indirect’ (Murray 2010). The *ASSUMED* category has also been called ‘inference from reasoning’ (Willett 1988) and ‘inferential’ (Murray 2010).

- (180) a. *INFERRED*: Inference based on results, visual evidence, or reasoning  
b. *ASSUMED*: Inference based on reasoning and general knowledge  
(Aikhenvald 2004, p. 191)

As shown in Chapter 2, *will* does not completely align with *ASSUMED* evidentials because it is compatible with the speaker having visual evidence or evidence that is a result state. *Will*’s actual restriction is much more subtle: the evidence cannot be a result state of the prejacent. The difference between the *ASSUMED* and *INFERRED* evidentials, on the one hand, and *will*, on the other, is that the *ASSUMED* and *INFERRED* evidentials seem to require an inference and restrict an intrinsic property of the evidence the inference is based on (e.g., visual, results). *Will*, by contrast, requires an inference and restricts the type of inference (i.e., non-abductive).

#### 4.2.1.4 A problem posed by the Anaphoric Construction

There are many evidential categories that at least partially restrict the relation between the evidence and the prejacent rather than an intrinsic aspect of the evidence (e.g., direct, indirect, assumed, inferred). Even though the requirements of these evidentials are at least partially relational, they are described purely as a restriction on the evidence. If inherently relational restrictions such as these can be encoded as a restriction on the evidence, can this also be done for *will*? In this section, I will show that an analysis like this is untenable.

The basic approach used here is one in which an evidential carries a presupposition that the speaker has a particular type of evidence for the asserted proposition, as in (181).

- (181) a. assertion:  $p$   
 b. presupposition: speaker has INDIRECT EVIDENCE for  $p$

Given that *will* is an epistemic modal, the denotation in (181) will have to be integrated with the semantics of epistemic modality. As discussed previously, one way to do this is to restrict the worlds in the modal base (*à la* Matthewson et al. 2007, Matthewson 2015). Under this approach, an epistemic modal like *must* is analyzed as restricting the modal base to only those worlds in which the INDIRECT EVIDENCE for  $p$  holds, as in (182).

- (182)  $\llbracket \text{must } \varphi \rrbracket^{w,f}$  is only defined if for all worlds  $w', w' \in f(w)$  iff the INDIRECT EVIDENCE for  $\varphi$  in  $w$  holds in  $w'$

The parallel for *will* is less intuitive. Since *will* restricts the inference type, the presupposition must make reference to the inference rather than indirectly requiring an inference through restricting the evidence type (as is done with INDIRECT EVIDENCE). The presupposition for *will* might restrict the modal base to only those worlds in which the ‘non-abductive inference’ that leads to  $p$  holds.

- (183)  $\llbracket \text{will } \varphi \rrbracket^{w,f}$  is only defined if for all worlds  $w', w' \in f(w)$  iff the NON-ABDUCTIVE INFERENCE that leads to  $\varphi$  in  $w$  holds in  $w'$

The presupposition in (183) relies on the category NON-ABDUCTIVE INFERENCE to identify inferences as (non-)abductive. In what follows, I will show that even if we assume that this category can be used to identify (non-)abductive inferences, this analysis is still untenable. Recall the contrast between the Anaphoric Construction (AC) and their Non-Anaphoric (NA) counterparts, as in (184)-(187).

- (184) *Smoky barbecue context*
- a. That will be the neighbors barbecuing. =AC
  - b. #The neighbors will be barbecuing. =NA
- (185) *Kaeli is baking cookies. She sees smoke coming from the oven and says:*
- a. That will be my cookies burning.
  - b. #My cookies will be burning.
- (186) *John is in the attic fixing something. You hear stomping coming from the ceiling.*
- a. That will be John in the attic.
  - b. #John will be in the attic.
- (187) *Context: The phone rings. Your mother always calls around this time.*
- a. That will be my mother calling.
  - b. #My mother will be calling.

The AC sentence (184a) is felicitous in the smoky barbecue context, but its NA counterpart (184b) is not. Chapter 2 argued that the inference that leads to the NA sentence is abductive, while Chapter 3 argued that the inference that leads to the AC sentence is not abductive. Chapter 3 also showed that the AC sentences entail their NA counterparts, as in (188).

- (188) ENTAILMENT WITH (184)-(187)
- a. That is the neighbors barbecuing  $\Rightarrow$  the neighbors are barbecuing.
  - b. That is the cookies burning  $\Rightarrow$  the cookies are burning.
  - c. That is John in the attic  $\Rightarrow$  John is in the attic.
  - d. That is my mother calling  $\Rightarrow$  my mother is calling.

The inference from the evidence available in the smoky barbecue context to the NA sentence (e.g., the neighbors are barbecuing) is abductive. The presence of smoke (trigger) is explained

by the fact that the neighbors are barbecuing, alternatively the smoke is the result of the neighbors' barbecuing. This inference is schematized below in (189).

- (189) ABDUCTIVE INFERENCE that leads to NA sentence
- a. evidence (E) = there is smoke, barbecues cause smoke, the neighbors usually barbecue...
  - (i) E to NA =abductive

On the other hand, the inference that the AC sentence relies on constitutes a non-abductive inference. Let's call this the *E(vidence) to AC inference*.

- (190) NON-ABDUCTIVE INFERENCE that leads to AC sentence
- a. E = there is smoke, barbecues cause smoke, the neighbors usually barbecue...
  - (i) E to AC =non-abductive

Minimally, this type of analysis would need to identify the E to NA inference as abductive, in order to predict that *will* is incompatible with it, and to identify the E to AC inference as non-abductive because *will* is compatible with it.

Additionally, I assume the inference between the AC sentence and its NA counterpart is also non-abductive, since the relation between the two propositions is simply entailment. Let's call this the *AC to NA inference*. From the evidence, the speaker can non-abductively infer the AC sentence (E to AC), and from the AC sentence the speaker can non-abductively infer the NA counterpart (AC to NA). Taken together there is a non-abductive inference from the evidence to the NA sentence (E to AC + AC to NA). This is represented in (191).

- (191) NON-ABDUCTIVE INFERENCE that leads to NA sentence
- a. E = there is smoke, barbecues cause smoke, the neighbors usually barbecue...
  - (i) E to AC =non-abductive
  - (ii) AC to NA =non-abductive

This means that in the smoky barbecue context there is both an abductive and a non-abductive inference that leads to the NA sentences. If there is a non-abductive inference that leads to the NA sentence, then the presupposition in (183) is satisfied, as we expect the NA sentences to be felicitous with *will*. This is a problem for any analysis which requires that the speaker has inferred the prejacent through non-abductive reasoning without having a more articulated theory of inference types. If there is a non-abductive inference to the AC sentence, there will necessarily also be one to the NA counterpart.

An analysis based on vF&G's structured modal bases will also have the same difficulty. Any kernel (set of propositions) that makes the AC sentences true in all the worlds in the modal base  $B_K$  (the modal base based on that kernel) will also make the NA counterpart true. This is because there is no way to distinguish between the entailments of  $K$  and the entailments of the entailments of  $K$  when  $B_K$  is a set of worlds.

#### 4.2.2 Evidence relations

The previous section showed that an analysis which restricts the evidence for a proposition, rather than the relation between the evidence and the proposition, cannot account for the restriction on *will*. Krawczyk (2012) analyses all evidentials as inherently relational. The categories DIRECT, INDIRECT, HEARSAY, ASSUMED, etc. all denote an "evidence relation." The relation between the evidence and the proposition is indirect, rather than the evidence itself being indirect. This might be what we would ultimately want to account for the inferential restriction of *will*.

In addition to all evidential categories denoting an evidence relation, Krawczyk (2012) also claims that those relations are always abductive. She claims an evidential relation that holds between evidence and the embedded proposition is always an abductive one. The proposition marked with the evidential is an *explanation* of the presence of the evidence. For example, for an INDIRECT evidential, the speaker might observe tissues on John's desk and conclude that John is sick. In this case, John's being sick *explains* why there are tissues on his desk.

A basic evidence relation is given in (192). An evidence relation takes three arguments: an agent  $a$ , an observation  $e$  (what I have called a trigger), and a proposition  $p$  (for modals, this is the prejacent).  $K_a$  is the knowledge set of the agent.

(192) A BASIC EVIDENCE RELATION  $R(a, e, p)$

In an evidence context  $C_{EV}$ , there is an evidence relation of the form  $R(a, e, p)$  that may be expressed by an evidential, if and only if

- a.  $e$  is an observation by  $a$ , and  $K_a$  is expanded to conclude  $e$  ( $K_a + e$ );
- b.  $p$  is the hypothesis which is the best-fit explanation of  $e$ , given  $K_a$ , in  $C_{EV}$

In Krawczyk’s (2012) analysis, all evidence relations take the basic form in (192) and therefore all require an abductive inference. I will not cover all of the evidential relations she defines in the dissertation. As an example, the difference between **DIRECT** and **INDIRECT** evidential relations is in speaker certainty—that is, whether the proposition is the *only* best-fit explanation of the evidence (**DIRECT**), or *one* of the best-fit explanations (**INDIRECT**). She writes: “The direct and indirect evidence relations differed in terms of how certain an agent was that his explanation expressed is true” (p. 224). The relevant evidence relations are given in (193).

(193) THE DIRECT AND INDIRECT EVIDENCE RELATIONS

In an evidence context  $C_{EV}$ , an evidence relation is

- a. A **Direct** relation, of the form  $(R_D(a, e, p))$ , if and only if
  - (i)  $a$  is *certain* that  $p$ , as
  - (ii)  $p$  is the best-fit and only fitting explanation of  $K_a + e$ , given that  $K_a + e$  does not include false assumptions with respect to  $C$  that would make  $e$  false.
- b. An **Indirect** relation, of the form  $(R_I(a, e, p))$ , if and only if
  - (i)  $a$  remains *uncertain* that  $p$ , as

- (ii)  $p$  is the best-fit explanation but not the only fitting explanation of  $K_a + e$ , given that  $K_a$  does not include false assumptions with respect to  $C_{EV}$  that would make  $e$  false. = (287, p. 231)

Consider the wet umbrellas context. In this context, the observation  $e$  is that there are wet umbrellas. The relation between this observation and the proposition *there are wet umbrellas* is a DIRECT one. The best explanation for observing wet umbrellas is that there are wet umbrellas. In most contexts, this is the best-fit and only explanation for observing wet umbrellas. In contrast, the relation between this observation and the proposition *it is raining* is an INDIRECT one. The best-fit explanation for observing wet umbrellas is that it is raining, but there are other possible explanations (someone could be shooting a film, or have used the umbrellas as protection in a water gun fight, etc.).

In addition to INDIRECT, DIRECT, and HEARSAY evidentials, Krawczyk (2012) also discusses ASSUMED and APPARENT evidentials. She shows that the ASSUMED evidential (e.g., *presumably* in English) is felicitous in all cases of (indirect) inferential reasoning: abduction, deduction, and induction. As is shown here, she claims that *must* (and *might*) are also felicitous with all types of reasoning. Given the claim that all evidentials require abductive reasoning, she suggests that one explanation for this fact is that these lexical items are not evidentials. She writes:

We do not see, however, any arguments which illustrate how the ASSUMED differs from epistemic modals such as *must* or *might* (all cases where *presumably* is felicitous *must* is as well). The proposal given here also does not have any arguments to offer here with respect to how the evidence signal of the ASSUMED differs from that of the epistemic modal; this may be an issue for further investigation. (p. 243)

I remain agnostic to Krawczyk's (2012) claim that all evidentials require abductive reasoning or that evidentials differ in speaker certainty. Certainly, epistemic modals do not conform to this generalization.

The shift from encoding evidential meaning as a restriction on evidence type to restricting an evidence relation is an appealing one. Moreover, it provides a framework which could po-

tentially be useful for modeling the difference between *will* and *must*. There is still much work to be done to determine how the evidence relations might be used to account for epistemic modals. Epistemic modals, at least *must* and *will*, differ from how Krawczyk's (2012) analyzes indirect evidentials in two respects. The first difference is in speaker certainty: both *must* and *will* can be used when the speaker is certain, whereas Krawczyk (2012) claims that indirect evidentials require that the speaker is not certain. The second difference is that *will* and *must* do not require abductive reasoning. In fact, *will* has the opposite requirement: it is incompatible with abductive reasoning.

An analysis based on evidence relations (as opposed to evidence types, like in Section 4.2.1) may be able to account for the contrast between the AC sentences and their NA counterparts. This is because the relation is calculated by comparing the relation between the observation (trigger) and the prejacent, rather than requiring a particular type of evidence. Within this framework, *will* would require that the prejacent not be a best-fit explanation for the prejacent. Since both the observation and the prejacent are represented in the semantics, their relation can be compared in a way that is not possible in the approaches discussed in Section 4.2.1. A complete analysis would require a theory of inference types and how they are encoded in the semantics.

### 4.3 Theoretical Desiderata

While both PT *will* and epistemic *must* require that the prejacent is concluded through an inference, they differ in what types of inferences they are compatible with. Below is a summary of the desiderata for any analysis of PT *will* and how it differs from epistemic *must*. In Chapter 7, I will show that these properties of PT *will* actually hold for all uses of *will*.

(194) PROPERTIES OF PT *will* AND EPISTEMIC *must*

- a. PT *will* and epistemic *must* are incompatible with direct evidence.
- b. Epistemic *must* is compatible with any inference that supports a universal claim.
- c. PT *will* is incompatible with abductive inferences.



- d. PT *will* shows a contrast between AC sentences and NA counterparts, but epistemic *must* does not.

Without a theory of different inference types, it is difficult to predict what an analysis of these facts would look like. Section 4.2.1 argued that an analysis which restricts the type of evidence is both unintuitive for encoding *will*'s inferential restriction and cannot account for the contrast between AC sentences and their NA counterparts (desideratum (194d)). Section 4.2.2 described how an evidence relation *à la* Krawczyk (2012) might be used to restrict the inference between an observation and the prejacent. While this framework seems promising for modeling differences in epistemic modals, it is difficult to evaluate without a clear picture of how different inference types differ from one another. It is possible that the difference between *will* and *must* will fall out naturally from the difference between abductive and non-abductive inferences and a seemingly independent difference between *will* and *must*. One such difference is discussed in Part 2 of the dissertation: how epistemic modals interact with negation.

Part II

# Epistemics and Negation

## CHAPTER 5

### Interactions between epistemics and negation

This chapter discusses the interaction between negation and the epistemic *must* and present-tense (PT) *will*. As a first observation, both modals are interpreted above clause-mate negation. Neither of the sentences in (195) has an interpretation where the modal is interpreted in the scope of the negation.

- (195) EPISTEMIC MODALS AND NEGATION
- a. The neighbors must not be barbecuing (right now).
    - (i) ✓ MUST > NEG
    - (ii) ✗NEG > MUST
  - b. The neighbors won't be barbecuing (right now).
    - (i) ✓WILL > NEG
    - (ii) ✗NEG > WILL

Following Homer (2015), I take there to be (at least) two possible sources of this behavior: the lexical items are Positive Polarity Items (PPIs) or Neg-Raising Predicates (NRPs). This section examines how these modals interact with negation in a variety of syntactic configurations. It uses tests developed by Homer (2015) for testing PPI-hood. The result for PT *will* is that it systematically fails these tests, making it unlikely that PT *will* is a PPI. In Chapter 6 I will argue further that *will* should be analyzed as a NRP. The result for epistemic *must* is less clear. It passes some tests for PPI-hood, but it does not behave like a NRP as PT *will* does.

## 5.1 Brief description of NRPs and PPIs

This section briefly discusses two ways lexical items can be lexically specified to be interpreted above negation. A more complete discussion of Neg-Raising Predicates will be provided in Chapter 6.

Neg-Raising Predicates (NRPs) were first described by Fillmore (1963). This class of predicates give rise to an inference that corresponds to the negation being interpreted lower than its surface position, as shown in (196a) for the NRP *think*.

- (196) a. Adam doesn't think that Chad is home.  
           $\rightsquigarrow$  Adam thinks Chad is NOT home.
- b. Adam isn't certain that Chad is home.  
           $\rightarrow$  Adam is certain Chad is NOT home.

(196a) can be compared with (196b) which contains the predicate *certain*. *Certain* is not a NRP, and a parallel reading with negation interpreted in the lower clause is not available.

There have been two main types of analyses for NRPs: syntactic (Fillmore 1963, Collins, Postal, and Horn 2014) and semantic/pragmatic (Bartsch 1973, Horn 1978, Gajewski 2007, Romoli 2013). In this dissertation, I will focus on the semantic/pragmatic analyses; see Gajewski (2007), Romoli (2013) for arguments against the syntactic analysis. A more complete description of the presuppositional analyses (Gajewski 2005, 2007) and the scalar implicature analysis (Romoli 2012, 2013) is provided in Chapter 6.

The semantic/pragmatic analyses center around the idea of an Excluded Middle (Ex-Mid) inference first introduced by Bartsch (1973). Under these analyses, NRPs are lexical items that trigger an opinionatedness or settledness inference. An example of this is given below in (197).

- (197) Adam doesn't think Chad is home.
- a. Assertion:  $\neg\text{think}_q(\text{home}(c))$

- b. Ex-Mid inference:  $\text{think}_a(\text{home}(c)) \vee \text{think}_a(\neg\text{home}(c))$
- c. Assertion + Ex-Mid =  $\text{think}_a(\neg\text{home}(c))$

The Ex-mid inference of (197) can be described as “Adam has an opinion about whether Chad is home or not.” If it isn’t the case that Adam thinks that Chad is home (the asserted content) and that Adam definitely has an opinion about this, then it must be that he thinks Chad is not home. By virtue of the presence of the Ex-Mid inference, these predicates appear to be interpreted outside of the scope of negation.

Another reason why a lexical item might appear to be interpreted outside of negation is if it is a Positive Polarity Item (PPI). An example of a PPI is given in (198).

(198) Adam didn’t eat something.

- a. ~~NEG~~ > SOME
- b. SOME > NEG

The lexical item *some* is a PPI and thus cannot be interpreted in the scope of an operator like negation. Polarity Items (PIs) are lexically specified for which type of operators or environments they can occur in the scope of. Negative Polarity Items are only licensed in the scope of an operator or in an environment that licenses inferences from sets to subsets (Ladusaw 1979). These are downward entailing operators, as defined below in (199).

(199) DEFINITION OF A DOWNWARD ENTAILING OPERATOR

A function  $F$  is downward entailing iff

for all  $A, B$  in the domain of  $F$  such that  $A \Rightarrow B, F(B) \Rightarrow F(A)$

Downward entailing operators are those that flip the entailment relations of their arguments. NPIs require downward entailingness and thus always scope below operators like negation. In contrast, PPIs have the opposite requirement and thus cannot scope under negation.

In the next section, I use Homer’s (2015) tests for whether a lexical item is a PPI. These tests rely on the particular theory of PIs put forth by Homer (2012). I will provide a brief description of this analysis here, but the reader is referred to Homer (2012) for a complete description and arguments for this approach to PI licensing. For each of the tests, I will also present Homer’s examples with the well-known PPI *some*. This can be used as a baseline to which the behavior of the modals can be compared.

Following Gajewski (2005), Homer (2012) takes the licensing of PPIs to be environment-based, rather than operator-based. That is, a PPI is licensed as long as there is one constituent that is not downward entailing. The definition of downward entailing environments is given below (Gajewski 2005 cited in Homer 2015).

(200) DOWNWARD-ENTAILINGNESS OF A CONSTITUENT (Gajewski 2005):

A constituent  $A$  is DE with respect to a position of  $\alpha$  ( $\llbracket \alpha \rrbracket \in D_\alpha$ ) iff the function  $\lambda x. \llbracket A[\alpha/v_{\alpha,i}] \rrbracket^g[v_{\alpha,i} \rightarrow x]$  is DE, where  $A[\alpha/v]$  is the result of replacing  $\alpha$  with  $v$  in  $A$ .

Homer shows that licensing of a PPI can be local rather than global. Even though a sentence may have a particular monotonicity, a PI can be licensing in a portion of the structure that has a different monotonicity value. This is achieved by a licensing condition that checks a polarity item’s environment for its monotonicity at LF, as below.

(201) LICENSING CONDITION OF POLARITY ITEMS (Homer 2015):

A PI  $\pi$  is licensed in sentence  $S$  only if there is at least one domain of  $\pi$  which has the monotonicity properties required by  $\pi$  with respect to the position of  $\pi$ .

This licensing mechanism accounts for the fact that a PPI can be licensed in an environment that is globally downward entailing. This difference between local and global environments is what is exploited in Homer’s (2015) tests for whether a lexical item is a PPI.

### 5.1.1 Homer's tests for PPIs vs. Neg-Raisers

Homer (2015) discusses how deontic modals, specifically deontic *must* and *should*, interact with negation. Like epistemic *must* and *will* in (195), these modals are also interpreted above clause-mate negation, as shown in (202).

(202) DEONTIC MODALS AND NEGATION

- a. John mustn't jog.
  - (i) ✓ MUST > NEG
  - (ii) ✗NEG > MUST
- b. John shouldn't jog.
  - (i) ✓ SHOULD > NEG
  - (ii) ✗Neg > SHOULD

Homer concludes that deontic *must* is a (mobile) PPI and that deontic *should* has mixed properties – it is both a PPI and a NRP. Below is an overview of Homer's tests that I will use with the epistemic modals. In the following section, I will go through these tests in more detail and discuss the motivation behind them. For a complete discussion of these tests, I refer the reader to Homer (2012, 2015).

(203) **Homer's tests for PPIs vs. Neg-Raisers:**

- a. §5.2.1 Scopes above matrix negation (both PPIs and Neg-Raisers)
  - (i) ✓NRP/PPI > NEG
  - (ii) ✗NEG > NRP/PPI
- b. §5.2.2 Scopes below superordinate negation (only PPIs)
  - (i) Is it licensed under neg-raising predicate?/Does it participate in cyclic neg-raising?
  - (ii) How is the lexical item interpretation with negative quantifier (e.g., subject *no one*)?

✓THINK > NEG > PPI

✓THINK > NRP > NEG

- c. §5.2.3 Shows “rescuing” effects (only PPIs)
  - (i) ✓RESCUER > NEG > PPI
- d. §5.2.4 Shows “shielding” effects (Only PPIs)
  - (i) ✓NEG > SHIELD > PPI

The tests all exploit the local licensing of PIs. They all involve cases of globally downward entailing environments, but the PPI is licensed in a locally non-downward entailing environment.

In the next section, Homer’s tests are used to determine whether epistemic modals *must* and *will* are PPIs or NRPs. Both modals show the basic property of scoping above clause-mate negation, as shown in (195), which is a property shared by both PPIs and NRPs. The tests show that PT *will* patterns with NRPs but that epistemic *must* does not clearly pattern with either category.

It would be premature to conclude from these tests that *will* should receive the same analysis as traditional NRPs. Chapter 6 discusses at least one way that PT *will* is different from traditional NRPs such as *think*. The focus of this chapter is only the empirical facts. I will discuss whether a modal “scopes” above or below negation. This isn’t meant this to be an analysis, these terms are simply used to describe the relative scope in the interpretation. The next step is to determine how these facts should be encoded in the semantics. This is done in Chapter 6.

## 5.2 Extending Homer’s tests to epistemic modals

Homer (2015) argues that deontic *must* is a (mobile) PPI, not a NRP. I will use the behavior of deontic *must* as a baseline for how a PPI modal behaves. The tests will all follow the template in (204). The (a) example is deontic *must* and taken directly from Homer (2015), unless otherwise stated. The (b) example is epistemic *must* and (c) is PT *will*.



- (204) TEST TEMPLATE
- a. deontic *must* (baseline for modal PPI)
  - b. epistemic *must*
  - c. PT *will*

The examples for deontic *must* include an eventive predicate, whereas the other two (b-c) contain stative predicates. This is an easy way to induce the correct interpretation, root verses epistemic (see Chapter 2).

For the most part, Homer's tests can be straightforwardly applied to epistemic modals. There are two exceptions to this. First, it is unacceptable for *must* to have cliticized negation (e.g., *mustn't*) when it is interpreted as epistemic (Zwicky and Pullum 1983). While *mustn't* in (205a) is a bit stilted as a deontic modal, it is completely unacceptable in (205b) with an epistemic interpretation.<sup>1</sup>

- (205) a. John *mustn't* play outside after dark.  
b. #John *mustn't* be the murderer.

For one of the tests, rescuing, it is important to use cliticized negation (e.g., *mustn't*) because *must not* may create a bi-clausal structure. The result is that this test is inconclusive for epistemic *must*. PT *will* occurs freely with cliticized negation (e.g., *won't*), and *will* is the primary focus here anyways.

The second exception involves deciding what the meaning of a sentence would be if *will* were interpreted in the scope of negation. I will assume that present-tense (PT) *will* is a universal modal, as discussed in Chapter 2. This means that both epistemic *must* and PT *will* encode universal quantification over worlds. As will be shown shortly, if this assumption is correct, then unlike epistemic *must*, PT *will* never scopes under negation. For this reason, it can be difficult to assign a good paraphrase for what a sentence would mean if *will* were

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<sup>1</sup>There may be some speaker variation on this point, but in general *mustn't* seems to be more easily interpreted as deontic than epistemic.

interpreted in the scope of negation. We need to know what the interpretation would be to determine whether or not the sentence has that interpretation. In an attempt to do this, I have based the paraphrases on the meaning that arises when other universals are interpreted in the scope of negation. Consider the example with the universal *have to* in (206).

(206) John doesn't have to be home right now, but he might be.

(206) can have an epistemic interpretation in a context in which we are considering all kinds of evidence. At first we think John isn't scheduled to work, so he must be home. But then we find out his best-friend is visiting and they enjoy doing outdoorsy activities together. Once considering this additional evidence, we decided that it isn't necessary that John is home right now. This inconclusiveness could be reported with (206) but not with (207).

(207) John won't be home right now/tomorrow, #but he might be.

- a. WILL > NEG
- b. ~~X~~NEG > WILL

If *will* is a universal, then if it scopes under negation, the interpretation should be the negation of a universal claim, similar to (206). The negation of a universal claim ( $\neg\Box p$ ) is compatible with an existential version of the claim ( $\Diamond p$ ), as in the continuation in (207). To achieve an interpretation in which negation scopes over *will*, *it's not necessary that...* will be used to approximate the intended interpretation, modeling the interpretation in (206) with *have to*.

### 5.2.1 Clause-mate/matrix negation

The first test is whether the modal scopes outside of clause-mate negation. The easiest way to test this is with a simple unembedded clause containing both the lexical item and negation. Both PPIs and NRPs scope outside of clause-mate negation, so this test just establishes that there is reason to believe that the lexical item is either a PPI or NRP.

Examples of this test for a standard PPI *some* (208) and a standard NRP *think* (209) are given below. Notice that the NRP *optionally* scopes above negation, whereas the PPI *obligatorily* scopes above negation. I'll return to this point in Chapter 6.

- (208) When Fred speaks French... some=PPI
- a. Jean-Paul doesn't understand something.
- (i)  $\checkmark$ SOME>NEG, \*NEG>SOME =(31)
- (209) John doesn't think that he's competent.
- a. *Paraphrasable as:* John thinks he is not competent. think=NRP
- b. *Paraphrasable as:* John doesn't have the belief that he's competent. (Non-NR reading)

This test is replicated below for the modals, also in (195). As Homer shows, deontic *must* is necessarily interpreted outside the scope of negation in (210a). The same pattern is replicated for epistemic *must* in (210b) and PT *will* in (210c). In all of these sentences, it is contradictory to continue with an existential claim. These continuations should not be contradictory if the universal is interpreted in the scope of the negation ( $\diamond$  is compatible with  $\neg\Box$  but not with  $\Box\neg$ ). This shows that the modals are not interpreted in the scope of the negation.

- (210) TEST 1: CLAUSE-MATE NEGATION
- a. John mustn't jog, #but he's allowed<sub>deon</sub> to. Deontic *must*
- (i)  $\checkmark$ MUST>NEG
- (ii)  $\times$ NEG>MUST
- b. John must not be home, #but he might be. Epistemic *must*
- (i)  $\checkmark$ MUST>NEG
- (ii)  $\times$ NEG>MUST
- c. John won't be home (right now), #but he might be. PT *will*
- (i)  $\checkmark$ WILL>NEG

(ii) ✗NEG>WILL

Compare the interpretation of (210b) and (210c) with that of *have to* in (206) repeated below.

(211) John doesn't have to be home right now, but he might be.

In (211), the universal *have to* is interpreted in the scope of negation and the possibility continuation is not contradictory.

It is also notable that future uses of *will* also scope outside of negation, as in (212). Compare the interpretation in (212) with *it doesn't have to rain tomorrow, but it might*.

(212) It won't rain tomorrow, #but it might.

a. ✓WILL>NEG

b. ✗NEG>WILL

If the future use of *will* is also a universal modal, and if it were interpreted in the scope of negation, then we would expect (212) to be compatible with the existential continuation. I will return to this point in Chapter 6.

From the data in (210), we can conclude that epistemic and deontic *must* as well as PT *will* are both interpreted outside the scope of matrix/clausmate negation. This data is consistent with the lexical items being either PPIs or NRPs.

### 5.2.2 Superordinate negation

The next test is how the modals scope with respect to a negation located in a higher clause (i.e., superordinate negation). Homer (2012) takes the licensing domain for PPIs like *some* to be a Polarity projection (although the domain for other lexical item may vary). This means that in determining the monotonicity of the environment of a PI, only a sub-portion of the structure needs to be considered. In the case of a simple unembedded negative sentence, as in (213a), there is only one polarity projection and it is downward entailing. Thus a PPI is only licensed

if it moves out of the scope of the negation. Consider instead a bi-clausal structure with negation in the higher clause, as in (213b). In this case, the global monotonicity (determined by PolP<sub>1</sub>) is downward entailing, but the monotonicity of the PolP local to the PPI (PolP<sub>2</sub>) is not downward entailing. Under Homer's theory, the PPI can be locally licensed in PolP<sub>2</sub>.

- (213) a. \* $[_{TP_1} [_{PolP_1} \text{not} [_{VP} \dots \text{PPI} ]]]$  Clause-mate negation  
 b.  $[_{TP_1} [_{PolP_1} \text{not} [\dots [_{TP_2} [_{PolP_2} [_{VP} \dots \text{PPI} ]]]]]]$  Superordinate negation

Given this, we expect that a PPI could occur in the scope of superordinate negation, even if it could not occur in the scope of clause-mate negation. Below is an example with the PPI *some* as an example of how a PPI behaves. Although *some* necessarily scoped above of negation in (208), in (214) *some* scopes below the negation introduced in the higher clause.

- (214) a. Sue doesn't think that Jean-Paul understands something. = (36)  
 (i)  $\checkmark(\text{THINK} >)\text{NEG} > \text{SOME}$   
 b. Jean-Paul doesn't understand something.  
 (i)  $\times \text{NEG} > \text{SOME}$

If, instead, the lexical item does scope above the superordinate negation, then it is likely not a PPI. If the lexical item is interpreted in the scope of negation the results are less clear. We expect NRPs might participate in cyclic Neg-Raising and be interpreted above the negation.<sup>2</sup> Below is an example of an NRP in the subordinate clause and negation in the superordinate clause. The NRP scopes above the negation giving rise to a cyclic Neg-Raising interpretation (i.e., *want* is interpreted above the negation).

- (215) a. John doesn't think Mary wants to leave.  
 (i) *Paraphrasable as: John thinks Mary wants to not leave.*  
 $\checkmark \text{THINK} > \text{WANT} > \text{NOT}$

<sup>2</sup>Note that the examples are set up to have *think* as the higher Neg-Raiser. This is because other configurations of Neg-Raisers (e.g., *want > think*) do not allow for cyclic Neg-Raising (Horn 1978).

I will use two version of this test (both discussed by Homer). First, I will replicate the test above using *don't think*. A problem with this test arises with epistemic *must* because it isn't clear that the negation is truth conditional and not metalinguistic. For this reason, I will also include a second test that is clearer: a negative quantifier and NRP in the superordinate clause. This eliminates the possibility of the negation being metalinguistic, giving much clearer results. To be thorough, I'll present both tests.

In (216)-(219) the modals occur in a subordinate clause under a negated NRP *think*. In (216), we see that deontic *must*, the PPI modal, is interpreted in the scope of negation.

(216) TEST 2: SUPERORDINATE NEGATION (deontic *must*)

- a. Mary doesn't think John must jog, she thinks he can if he chooses to.
  - (i) *Paraphrasable as: Mary thinks that it isn't necessary that John jogs.*  
 $\checkmark$ THINK > NEG > MUST
  - (ii) *Not paraphrasable as: Mary thinks it is necessary that John doesn't jog.*  
 $\times$ THINK > MUST > NEG

Epistemic *must* shows the same behavior as deontic *must*. This is shown in (217). Unlike (216), (217) seems to require specific intonation with emphasis on *must*. (217) is also most naturally uttered in response to a claim that Mary does think John must be home—a hallmark of metalinguistic negation. This interpretation, however, is the only possible interpretation for (217a). That is, epistemic *must* does not participate in cyclic Neg-Raising, which would result in *must* being interpreted above the negation (as in (217a-ii)).

(217) TEST 2: SUPERORDINATE NEGATION (epistemic *must*)

- a. Mary doesn't think John must be home (right now).
  - (i) *Paraphrasable as: Mary thinks that it isn't necessary that John be home now.*  
 $\checkmark$ THINK > NEG > MUST
  - (ii) *Not paraphrasable as: Mary thinks that it is necessary that John isn't home.*  
 $\times$ THINK > MUST > NEG

Consider a context in which (216) might be uttered, such as the crash space context in (218).

(218) *Crash space: Friends often stay at John's house when he is out of town. Bill needs somewhere to stay tonight so Sue consults Mary about whether John is home. Sue reports:*

- a. Mary doesn't think John must be home right now...
  - (i) ✓...she thinks he might be, we should check before we offer it to Bill.
  - (ii) #...so Bill can stay there.
- b. Mary thinks John must not be home right now...
  - (i) #...she thinks he might be, we should check before we offer it to Bill.
  - (ii) ✓...so Bill can stay there.

Sue's claim in (218a) can be continued with a possibility claim, compatible with an interpretation in which the negation scopes over *must*. (218a) cannot be followed with a continuation that would be compatible with the interpretation of *must* above negation. If it is necessary that John is not home, then Bill can stay there.

The acceptability of the continuations with (218a) can be compared with the continuations with (218b). In (218b), the negation is pronounced and interpreted in the lowest clause. If *must* did participate in cyclic Neg-Raising with *think*, we would expect (218a) to have, at least optionally, an interpretation equivalent to (218b).

PT *will* shows very different behavior from epistemic *must* in this environment. PT *will* is not, even optionally, interpreted in the scope of superordinate negation. This is shown in (219).

(219) TEST 2: SUPERORDINATE NEGATION (PT *will*)

- a. Mary doesn't think John will be home (right now).
  - (i) *Not paraphrasable as: Mary thinks it is not the case that John is necessarily home now.*

✗THINK > NEG > WILL

- (ii) *Paraphrasable as: Mary thinks it is necessary that John isn't home now.*

✓THINK > WILL > NEG

The contrast in interpretation between epistemic *must* and PT *will* in this environment is very clear ((217) v. (219)). This is also reflected in the possible continuations. Consider again the crash space context of (218). Sue's claim in (220a) has the opposite acceptable continuations as its counterpart with epistemic *must*.

- (220) a. Mary doesn't think John will be home right now...

(i) #...she thinks he might be, we should check before we offer it to Bill.

(ii) ✓...so Bill can stay there.

There is, however, a confound with the example containing epistemic *must*. It is possible that the negation is actually metalinguistic negation. Another way to test whether these lexical items can occur in the scope of superordinate negation is to use a negative quantifier, such as *no one*. Examples are given below in (221)-(223). This test replicates the results of the previous one: PT *will* scopes outside of superordinate negation, and deontic and epistemic *must* are interpreted within the scope of the negation in this environment. Because the results are the same, I will go through these examples more quickly.

- (221) TEST 2: SUPERORDINATE NEGATION – NEGATIVE QUANTIFIER (deontic *must*)

- a. No one thinks John must jog.

(i) *Paraphrasable as: Everyone thinks that it is not the case that John is required to jog.*

✓THINK > NEG > MUST

(ii) *Not paraphrasable as: Everyone thinks that John is required to not jog.*

✗THINK > MUST > NEG



(222) avoids the confound of metalinguistic negation that was observed for (217), yet epistemic *must* is still necessarily interpreted in the scope of the negation. The cyclic interpretation, where *must* scopes above the negation is unavailable.

(222) TEST 2: SUPERORDINATE NEGATION – NEGATIVE QUANTIFIER (epistemic *must*)

a. No one thinks John must be home.

(i) *Paraphrasable as: Everyone thinks that its not the case that John must be home.*

✓THINK > NEG > MUST

(i) *Not paraphrasable as: Everyone thinks that it must be the case that John is not home.*

✗THINK > MUST > NEG

Again, the contrast between epistemic *must* and PT *will* is clear in this environment. In (223), *will* cannot be interpreted in the scope of negation.

(223) TEST 2: SUPERORDINATE NEGATION – NEGATIVE QUANTIFIER (PT *will*)

a. No one thinks John will be home (right now).

(i) *Not paraphrasable as: Everyone thinks that it's not the case that John is necessarily home.*

✗THINK > NEG > WILL

(ii) *Paraphrasable as: Everyone thinks that it is necessarily the case that John is not home.*

✓THINK > WILL > NEG

The version with epistemic *must* (222) would be said in a context where everyone thinks that some evidence is inconclusive. For example, consider again the crash space context. Suppose we all know John's schedule and that he is usually on a work trip the first week of the month. But this month is the New Year's holiday, so maybe his schedule is different. If everyone

knows this, then we all think that it isn't necessary that John is home: he could or could not be. This situation could be reported by (222) but not by (223). In this case, Bill needs to check with John, he can't conclude from our information whether or not John is home. This is confirmed with the continuations in (224). Instead, (223) would be said in a context where John's schedule necessitates that he isn't home. For example, everyone knows that John is working on a big project out of state right now. This situation could be reported by (223) but not by (222). Again, this is confirmed with the continuations in (224).

- (224)
- a. No one thinks John must be home....
    - (i) ✓...they think it's possible he is though, so Bill should check with John first.
    - (ii) #...so Bill can stay there.
  - b. No one thinks John will be home right now..
    - (i) #...they think it's possible he is though, so Bill should check with John first.
    - (ii) ✓...so Bill can stay there.

From the tests discussed in this section, the following conclusions can be made: epistemic and deontic *must* scope below superordinate negation as the PPI *some* does, and PT *will* scopes above superordinate negation as some NRPs do, participating in cyclic Neg-Raising. In fact, unlike traditional NRPs, PT *will* necessarily participates in cyclic Neg-Raising. This will be discussed in more detail in Chapter 6.

### 5.2.3 Rescuing

The third test is whether the modals show effects of so-called “rescuing.” This is a phenomenon in which PPIs can occur in the scope of negation if there is a higher operator to rescue it. Rescuers are themselves downward entailing operators. Homer (2012) argues that the combination of two downward-entailing operators (a rescuer and negation) constitutes an upward-entailing environment for PPIs. Known rescuers are *only*, *few people*, and *no one*. (225) is an example of the PPI *some* being rescued.

- (225) When the class went fishing last week...
- a. ...only Maayan didn't catch something.
- (i) ✓ ONLY > SOME > NEG
- (ii) ✓ ONLY > NEG > SOME

(225) can have both of the interpretations listed. The first interpretation is salient in the following context: There were things the students were supposed to catch to practice their fishing skills. Each student needed to catch a trout, a plastic bag, and a piece of kelp. All of the students on the trip caught all three things, except Maayan, who only caught two of them. In this context, there was something that Maayan didn't catch, and (225a) can be used to report this (ONLY>SOME>NEG). The second interpretation is salient in a context where everyone in the class caught at least one fish, except Maayan, who didn't catch anything. This situation can also be reported by (225a) (ONLY>NEG>SOME).

In the tests in (226)-(230), I have chosen to use *only* as the rescuer. If the modal is a PPI, we expect it to be rescued by *only*. It will optionally occur in the scope of negation when a rescuer is present. If the lexical item is a NRP, we don't expect it to show rescuing effects. It is difficult to say exactly what is expected for Neg-Raising predicates because traditional Neg-Raisers (e.g., *think*) always show optional Neg-Raising. If *think* scopes below the rescuer, it is unclear if it is due to the presence of the rescuer or simply because the Neg-Raising of the NRP is optional. This is somewhat irrelevant because *will* obligatorily Neg-Raises and does not show rescuing effects. It obligatorily scopes outside of the negation in this environment.

Homer (2015) claims that deontic *must* shows rescuing effects, and (226) does have an interpretation where *must* scopes under negation. This interpretation, however, is not available for me or those I have consulted.

- (226) TEST 3: RESCUING WITH ONLY (deontic *must*)
- a. Only John mustn't jog.
- (i) *Paraphrasable as: John is the only one who is required to not jog.*
- ✓ ONLY > MUST > NEG

(ii) *Not paraphrasable as: John is the only one who doesn't have to jog.*

LW: ✗ONLY > NEG > MUST

Homer: ✓ONLY > NEG > MUST

For me, the only interpretation that is available is one in which John is required to not jog and no one else has this requirement. The judgments in (226) are made explicit with the acceptable continuations in (227).

(227) Only John mustn't jog.

a. ✓...his knees are too weak, everyone else is allowed to jog though.

b. #...but he is allowed to if he wants to, everyone else is required to jog.

Both epistemic *must* and PT *will* also do not show rescuing effects (228)-(230). They necessarily scope above negation. The test for epistemic *must* is given in (228).

(228) TEST 3: RESCUING WITH ONLY (epistemic *must*)

a. Only John must not be at home.

(i) *Paraphrasable as: John is the only one for whom it is necessary that he is not home.*

✓ONLY > MUST > NEG

(ii) *Not paraphrasable as: John is the only one for whom it is not necessary that he is home.*

✗ONLY > NEG > MUST

There is, however, a confound with the test with epistemic *must*. To perform the test correctly, we need to use cliticized negation, and negation cannot be cliticized to epistemic *must*. Given this, it is unclear what to conclude from (228a). It may be that the lack of the reading in which *must* scopes under negation is due to the fact that *must* is actually located in a superordinate clause to the negation.

The judgments in (228) are confirmed with the continuations in (229). The continuation in (229b) is only compatible with an interpretation in which *must* scopes below negation.

(229) Only John must not be home....

- a. ✓ ...he is scheduled to work right now.
- b. #...his schedule keeps changing, so he could or could not be home.

The same interpretations are available for PT *will*. This is shown in (230) with the possible continuations in (231).

(230) TEST 3: RESCUING WITH ONLY (PT *will*)

- a. Only John won't be home (right now).
  - (i) *Paraphrasable as: John is the only one for whom it is necessary that they are not home.*  
✓ ONLY > WILL > NEG
  - (ii) *Not paraphrasable as: John is the only one for whom it is not necessary that they are home.*  
✗ ONLY > NEG > WILL

(231) Only John won't be home....

- a. ✓ ...he is scheduled to work right now.
- b. #...his schedule keeps changing, so he could or could not be home.

None of the modals seem to show rescuing effects (but see Homer for a conflicting view of deontic *must*). For epistemic *must*, this test could be confounded by the fact that it does not occur with clefted negation. For PT *will* this test seems to show that it does not behave like a PPI (e.g., not like *some*).

## 5.2.4 Shielding

The final test is whether the modals show “shielding” effects. This is a phenomenon in which a PPI can occur in the scope of negation if a shield intervenes between the negation and the PPI. Shielders are strong scalar items. Homer (2012) adopts a theory in which the licensing of PIs is affected by scalar implicatures. The scalar implicatures introduced by a strong scalar item are “monotonicity breakers” in downward-entailing environments. For example, in (232) the PPI *some* can occur in the scope of negation when the quantifier *every* intervenes and shields the PPI from the negation.

- (232) Not everyone understands something. = (46)
- a.  $\checkmark$ NEG > EVERY > SOME

If the modal is a PPI, we expect it can occur in the scope of negation when a shielder intervenes. If the lexical item is an NRP, we don’t expect the presence of a shielder to affect the acceptability.

The shielding test for deontic *must* is given in (233). (233a) is true when not everyone is required to jog—for example, if some students have a choice whether or not to jog. It is compatible with the continuation *some students may choose whether or not they want to jog*.

- (233) TEST 3: SHIELDING WITH EVERY (deontic *must*)
- a. Not everyone must jog.
- (i) *Paraphrasable as: It’s not the case that everyone is required to jog.*  
 $\checkmark$ NEG > EVERY > MUST
- (ii) *Not paraphrasable as: It is required that not everyone jog, someone must not.*  
 $\times$ MUST > NEG > EVERY
- (iii) *Not paraphrasable as: It is required that everyone not jog.*  
 $\times$ MUST > EVERY > NEG

This is not the case for epistemic *must*. The interpretation that (233a) receives is ruled out for epistemic *must* by the Epistemic Containment Principle (ECP, von Stechow and Iatridou (2003)). *Every* cannot scope outside of the epistemic modal, as in (234a-i), because it would violate the ECP

(234) TEST 3: SHIELDING WITH EVERY (epistemic *must*)

a. Not everyone must be home (right now).

(i) *Not paraphrasable as: It's not the case that everyone is necessarily home.*

$\times \text{NEG} > \text{EVERY} > \text{MUST}$

(ii) *Paraphrasable as: It's necessary that not everyone is home.*

$\checkmark \text{MUST} > \text{NEG} > \text{EVERY}$

(iii) *Not paraphrasable as: It must be the case that everyone is not home.*

$\times \text{MUST} > \text{EVERY} > \text{NEG}$

Consider (234a) in the following context: Oliver, Anie, and Judith all live together. When they each come home, they turn on their light and turn it off when they leave. From the outside, we can see that only two lights are on. In this context, the evidence (lights) necessitate that not everyone is home.

*PT will* allows for the same interpretation possibility as epistemic *must*. If it is truly an epistemic modal, then we expect it to also obey the ECP. We cannot use the context described above with the lights because of the inferential restriction on *will* discussed in Part I of the dissertation. Consider (235a) in the following context: Oliver, Anie, Judith, and Brianna all live together. Oliver wants to call a house meeting, but Anie knows that Brianna is scheduled to be at work now. In this case, Anie might say (235a) and suggest a different time to hold the meeting.

(235) TEST 3: SHIELDING WITH EVERY (PT *will*)

a. Not everyone will be home (right now).

(i) *Not paraphrasable as: It's not the case that everyone is necessarily home right now.*

$\times \text{NEG} > \text{EVERY} > \text{WILL}$

(ii) *Paraphrasable as: It is necessary that not everyone is home right now.*

$\checkmark \text{WILL} > \text{NEG} > \text{EVERY}$

(iii) *Not paraphrasable as: It is necessary that everyone is not home right now.*

$\times \text{WILL} > \text{EVERY} > \text{NEG}$

Deontic *must* shows shielding effects with *every*. Epistemic *must* does not show shielding effects, but this interpretation is independently ruled out by the ECP. PT *will* also does not show shielding effects, which could be due to the ECP if PT *will* is indeed an epistemic modal. The shielding test supports an analysis in which deontic *must* is a PPI, but it does not support one in which the epistemic modals are.

### 5.3 Summary

The results of the tests from Section 5.2 are summarized below.

Figure 5.1: Summary of Homer's tests

Tests for PPI-hood	deontic <i>must</i>	epistemic <i>must</i>	PT <i>will</i>
1. Scopes above clause-mate negation	$\checkmark$	$\checkmark$	$\checkmark$
2. Scopes below superordinate negation	$\checkmark$	$\checkmark$	$\times$
3. Shows rescuing effects	$\times^{LW} / \checkmark^{VH}$	$(\times)$	$\times$
4. Shows shielding effects	$\checkmark$	(ECP)	(ECP)

It is difficult to draw any conclusions about epistemic *must* from the data presented in this chapter. Like deontic *must*, it is interpreted above the scope of clause-mate negation and is interpreted below superordinate negation. The results of the other two tests are less clear. The failure to show rescuing effects could be due to the fact that epistemic *must* cannot occur with cliticized negation. The failure to show shielding effects could also be independently explained by the ECP. Under a Kratzerian analysis in which different modal flavors are derived



from a single lexical item, it is surprising that epistemic and deontic *must* would differ in this respect, especially because PI-hood is generally thought of as a lexical specification or syntactic feature.

PT *will* does not show any properties of being a PPI: it scopes out of clause-mate negation, but it participates in cyclic Neg-Raising resulting in an interpretation in which *will* scopes above superordinate negation. This makes PT *will* look like a Neg-Raising Predicate. Chapter 6 shows that there are similarities and differences between traditional NRPs and *will*. Unlike traditional NRPs, there is strong evidence that the Neg-raising property of *will* is pre-suppositional. Like traditional NRPs, *will* participates in cyclic Neg-Raising and licenses strict NPIs in its scope. Chapter 6 also provides an analysis of these facts.

## CHAPTER 6

### Analysis of Neg-Raising with *will*

This chapter discusses previous analyses of traditional Neg-Raising Predicates (NRPs) and the properties of NRPs that have been crucial in motivating these theories. I will then discuss how a new class of NRPs—*strict* NRPs (i.e., *will*)—behave with respect to these properties. I show that *will* differs from traditional NRPs in that its Excluded Middle (Ex-Mid) inference is clearly presuppositional. In this dissertation, I will not add to the debate of how traditional NRPs should be analyzed. Instead, I will use traditional NRPs as a baseline for comparing the behavior of the Ex-Mid inference of *will*. I adopt Gajewski's (2005) presuppositional analysis, which was proposed for traditional NRPs, for *will*. I also discuss a connection between the Ex-Mid inference and future-tense marking, and I will suggest that there is a principled reason that future-tense markers might carry such an inference.

#### 6.1 Previous analyses of Neg-Raising

This section provides background on previous theories of what I will call traditional Neg-Raising Predicates (NRPs). I use this term to separate those predicates analyzed as NRPs in previous literature (e.g., *think*, *want*) from *will*. I also analyze *will* as a NRP: a predicate that carries an Ex-Mid inference. I refer to *will* as a *strict* NRP because its Ex-Mid inference is not cancelable. Traditional NRPs have been particularly difficult to analyze because their Ex-Mid inference seems to have mixed properties. With respect to some properties, the Ex-Mid seems to behave like an implicature, but with respect to other properties, it seems presuppositional. In contrast, *strict* NRPs do not show these mixed properties.

Before comparing *will* with traditional NRPs, I will first briefly discuss previous analyses of NRPs and the main data used to motivate these analyses. The literature on this topic is extensive, and I refer the interested reader to the original sources for a complete discussion of the analyses mentioned here. The brief discussion I provide does not do justice to the rich arguments that exist for and against each theory.

The focus of the discussion will be on the semantic/pragmatic approaches to Neg-Raising. There have, however, been syntactic approaches to this phenomenon Fillmore (1963), Collins et al. (2014). The basic idea of the syntactic approach is that the negation is generated in the lower clause and raises to the higher clause, as in (236).

(236) John NEG<sub>i</sub> thinks [<sub>TP</sub> Mary <NEG<sub>i</sub>> be home]

The higher copy of the negation is pronounced, but the lower copy is interpreted. I will not provide arguments against this approach. See Gajewski (2005) for arguments against Fillmore (1963), and see Romoli (2013) for a discussion of Collins et al. (2014).

I turn now to the semantic/pragmatic analyses. Starting with Bartsch (1973), NRPs have been analyzed as carrying an Ex-Mid inference, given schematically below in (237).

(237) Ex-Mid inference for a NRP  $P$  with arguments  $p$  and  $x$ :  $P_x(p) \vee P_x(\neg p)$

The debate in the semantics/pragmatics literature has centered around the semantic status of the Ex-Mid inference. In Bartsch's (1973) proposal, the Ex-Mid is analyzed as a pragmatic presupposition. Since then, the Ex-Mid has been analyzed as a "Short Circuited Implicature" (Horn and Bayer 1984), (hard) presupposition (Gajewski 2005), a soft presupposition (Gajewski 2007), derived via scalar implicatures within a theory of grammatical implicature (Romoli 2013), and as a homogeneity presupposition (Kriz 2015 following Gajewski 2005). I will not discuss all of these theories in depth but will instead discuss the data that lead to these analyses encoding the Ex-Mid in a variety of ways.

Even the most basic facts about Neg-Raising seem to provide conflicting evidence about the semantic status of the Ex-Mid inference. First, as Bartsch (1973) pointed out, the Ex-Mid inference seems to be easily canceled, as in (238). This led Bartsch to analyze the Ex-Mid as a pragmatic presupposition.

(238) John doesn't think Mary is home, because he doesn't have an opinion either way.

Horn (1978) points out that this analysis, however, fails to account for the idiosyncratic nature of Neg-Raising. For example, *want* is a NRP, but *desire* is not. These lexical items are very similar in meaning but differ in their Neg-Raising status. Likewise, if a lexical item is a NRP in one language, its counterpart in another language is not necessarily also a NRP. If Neg-Raising were derived through a general pragmatic principle, we wouldn't expect it to only apply to certain predicates in an unpredictable way. That said, Horn (1978) observes that NRPs are often positive midscalar operators.

To account for the idiosyncratic property, Gajewski (2005) proposes that the excluded middle should be analyzed as a semantic presupposition. This accounts for the fact that some lexical items are Neg-Raisers while others are not. NRPs are lexically specified and carry a presupposition such as the one in (239)

(239)  $\llbracket P \rrbracket = \lambda p \lambda x : [P(p)(x) \vee P(\neg p)(x)] . P(p)(x)$  = (6), Romoli (2013)

While this type of analysis accounts for the idiosyncratic property of NRPs, it fails to predict the defeasibility of the Ex-Mid. Gajewski points out, however, that specific intonation is needed to achieve the non-Neg-Raising reading, as in (240). Small caps is used to denote prosodic prominence or emphasis.

(240) a. John DOESN'T think Mary is home.  
 b. John doesn't THINK Mary is home.

Gajewski (2007) points out that the Ex-Mid does not behave like a hard presupposition in terms of projection out of other truth-conditional operators, such as epistemic modals, antecedent of conditionals, and questions.

(241) PROJECTION TESTS WITH NRP *think* =(19) Gajewski (2007)

- a. Perhaps, John thinks Mary has left.
- b. If John thinks Mary has left, he'll do something impertinent.
- c. Does John think Mary has left?

(242) PROJECTION TESTS WITH NON-NRP *say* =(20) Gajewski (2007)

- a. Perhaps, Mary said that Bill left.
- b. If Mary said Bill left, she'll do something impertinent.
- c. Did Mary say that Bill left?

(243) PROJECTION TESTS WITH FACTIVE *regret* =(21) Gajewski (2007)

- a. Perhaps, Mary regrets she said that.
- b. If Mary regrets that she said that, she'll do something impertinent.
- c. Did Mary regret that she said that?

The sentences in (241) do not carry the inference that John has an opinion about whether Mary has left. The Ex-Mid inference does not project. In these environments, *think* behaves just like non-NRP *say* in (242). The behavior of the Ex-Mid inference can be compared with the factivity of *regret* in (243). All of the sentences in (243) carry the inference that the proposition embedded under *regret* is true.

Despite the behavior in projection tests, the Ex-Mid inference does behave like a hard presupposition in some respects. This leads Gajewski (2007) to analyze the Ex-Mid as a soft presupposition *à la* Abusch (2002). Romoli (2013) proposes a new theory of NRPs in which the Ex-Mid inference is derived by scalar implicature within a system of grammaticized im-

plicatures à la Fox (2007). He cites Gajewski's (2007) observation that the Ex-Mid does not project out of truth conditional operators as evidence that the Ex-Mid is not a presupposition.<sup>1</sup>

Romoli (2013) adopts a theory in which scalar implicatures arise from an exhaustification operator with a meaning similar to *only*, defined in (244). Each lexical item comes with a set of alternatives, and this operator negates any alternative that would not contradict the asserted proposition, the excludable propositions, defined in (245).

$$(244) \quad \text{EXH}(\mathcal{A}lt(p))(p)(w) = p(w) \wedge \forall q \in \mathcal{E}xcl(p, \mathcal{A}lt(p))[\neg q(w)]$$

$$(245) \quad \mathcal{E}xcl(p, \mathcal{A}lt(p)) = \{q \in \mathcal{A}lt(p) : \lambda w[\neg q(w)] \cap p \neq \emptyset\}$$

In Romoli's (2013) analysis, the difference between NRPs and non-NRPs is in their lexical alternatives. NRPs have the Ex-Mid as an alternative, as in (246).

$$(246) \quad \mathcal{A}lt(\text{think}) = \left\{ \begin{array}{l} \text{think}_x(p) \\ \text{think}_x(p) \vee \text{think}_x(\neg p) \end{array} \right\}$$

In a negative sentence, as in (247), the Ex-Mid alternative is not excluded, since the asserted proposition does not entail it. The alternative set is given in (248).

(247) John doesn't think Mary is home.

a.  $p = \text{Mary is home}$

b.  $\neg \text{think}_j(p)$

$$(248) \quad \mathcal{A}lt(\text{think}_j(p)) = \left\{ \begin{array}{l} \neg \text{think}_j(p) \\ \neg \text{think}_j(p) \vee \text{think}_j(\neg p) \end{array} \right\}$$

---

<sup>1</sup>He also takes issue with use of soft presuppositions. See Romoli (2013) for this argument.

If the Ex-Mid alternative is not excluded from the alternative set, then it will be negated in the exhaustification process, as in (249). This essentially reaffirms the Ex-Mid alternative, in effect giving rise to an Ex-Mid implicature.

- (249)  $\llbracket \text{EXH} \rrbracket (\neg \text{think}_j(p))$
- a.  $= \neg \text{think}_j(p) \wedge \neg \neg (\text{think}_j(p) \vee \text{think}_j(\neg p))$
  - b.  $= \neg \text{think}_j(p) \wedge (\text{think}_j(p) \vee \text{think}_j(\neg p))$
  - c.  $= \text{think}_j(\neg p)$

This analysis accounts for the apparent pragmatic nature of the Ex-Mid: it is cancelable and doesn't project out of truth conditional operators. But it also accounts for the idiosyncratic nature of Neg-Raising: which lexical items have the Ex-Mid as an alternative can be stipulated.

Kriz (2015) points out that the Ex-Mid alternative proposed by Romoli (2013) aren't "lexical" alternatives. Instead, these alternatives are unpronounceable formulas. Kriz develops an idea originally proposed by Gajewski (2005) in which the Ex-Mid is actually a homogeneity presupposition. This analysis, just like all the previous analyses discussed has its drawbacks. Thus, it is left as an open question as to how the Ex-Mid inference of traditional NRPs should be analyzed.

### 6.1.1 Interim Summary

The semantic status of the Ex-Mid inference of traditional NRPs is unclear. It displays properties of a pragmatic phenomenon: It is cancelable and doesn't project out of truth-conditional operators. It also displays properties of a semantic phenomenon: It appears to be idiosyncratic which predicates are Neg-Raisers. In the next section, I will discuss how *will* behaves with respect to these properties above, as well as additional properties: cyclic Neg-Raising and licensing of strict NPIs. I will show that *will* patterns with Neg-Raisers in its cyclicity and licensing of strict NPIs, but it does not, however, pattern with traditional NRPs with respect to the presupposition tests. While traditional NRPs fail tests for their Ex-Mid being presupposi-

tional, *will* passes those tests. Thus, the semantic status of the Ex-Mid inference of *will* is much clearer than that of traditional NRPs.

## 6.2 Comparing *will* and traditional NRPs

### 6.2.1 How *will* differs from traditional NRPs

Chapter 5 showed that present-tense (PT) *will* does not behave like a PPI; however, there is evidence that it also doesn't behave exactly like traditional NRPs either. This section focuses on the differences between PT *will* and traditional NRPs, such as *think*. It tests the semantic status of the Excluded Middle (Ex-Mid) inference for *will* and *think*. Much of this data concerning *think* has been previously discussed in the literature, but the comparison with PT *will* is novel to my knowledge.

In comparing PT *will* with traditional NRPs, it is important to recognize that they quantify over different sets of worlds. *Think* quantifies over worlds compatible with the speaker's doxastic alternatives. These are the worlds compatible with what the speaker believes. The Ex-Mid for *think* is given in (250). The semantics of attitude predicates will be discussed in more detail in Section 6.3.2.

(250) EXCLUDED MIDDLE FOR *think*:

$\llbracket \text{think } \varphi \rrbracket^{w,c,f}$  is defined only if

$$\forall w' \in DOX_{x,w} : [\llbracket \varphi \rrbracket^{w',c,f} = 1] \vee \forall w' \in DOX_{x,w} : [\llbracket \varphi \rrbracket^{w',c,f} = 0]$$

In contrast, PT *will* does not quantify over doxastic alternatives. There are two points of departure. First, *will* is epistemic, rather than doxastic. This is a meaningful difference if epistemic is understood as evidence-based epistemic modality, as discussed in Chapter 4. For an epistemic modal, like *must* or *will*, the prejacent must be inferred from some evidence, whereas a belief can come about through any unconstrained mechanism (e.g., I just have a feeling).



The second difference is, as discussed in Part 1 (Chapters 2-4), *will* carries an inferential restriction, PT *will* is incompatible with abductive reasoning. This is not the case for *think*. This difference is shown in (251) below.

- (251) Context: Seeing wet umbrellas and knowing the only cause for wet umbrellas is rain.
- a. I think it's raining.
  - b. #It will be raining.

In this chapter, I will ignore this difference, and adopt an “epistemic-only” analysis for *will*. Thus, the Ex-Mid inference for *will* is as in (252).

- (252) EXCLUDED MIDDLE FOR *will*:
- $\llbracket \text{will } \varphi \rrbracket^{w,c,f}$  is defined only if
- $$\forall w' \in \bigcap f_{\text{epist}}(w) : [\llbracket \varphi \rrbracket^{w',c,f} = 1] \vee \forall w' \in \bigcap f_{\text{epist}}(w) : [\llbracket \varphi \rrbracket^{w',c,f} = 0]$$

This section discusses tests for presupposition projection with *will* and *think*. It will be useful to keep in mind the differences discussed above for modal bases. In particular, I will take a view here that epistemic modal bases, in particular that of *will*, quantify over worlds compatible with some body of evidence, rather than an epistemic or doxastic state. Epistemic conversational backgrounds are generally defined as a set of facts or knowledge in a world. The shift to evidence-based epistemic modality is simply to define an epistemic modal base as worlds compatible with some body of evidence (see von Stechow and Gillies 2010, Kratzer 2012, Matthewson 2015).

The Ex-Mid for *will* in (252) simply requires that the epistemic modal base be settled. The commonality between the Ex-Mid inferences for *think* and for *will* is that they are both settledness conditions. For *think*, the Ex-Mid inference states that the set of doxastic worlds are settled on the issue of *p*. For *will*, the Ex-Mid inference states the worlds compatible with some body of evidence are either all *p* worlds or all  $\neg p$  worlds.

### 6.2.1.1 Defeasibility

The first difference between *will* and *think* is in the defeasibility of their Ex-Mid inference. Traditional NRPs optionally receive a Neg-Raising interpretation, as in (253).

- (253) John doesn't think Mary is home.
- a. John thinks that Mary is not home. NR reading
  - b. It's not the case that John thinks Mary is home. Non-NR reading

In contrast, *will* always has a Neg-Raising interpretation, as shown in (254). It cannot optionally be interpreted in the scope of negation, as *think* can.

- (254) John won't be home (right now).
- a. It will be the case that John is not home. NR reading
  - b. ~~X~~It's not the case that John will be at home. Non-NR reading

Gajewski (2007) points out that (253) must be produced with particular intonation to achieve the non-Neg-Raising reading. Regardless of the intonation, (254) only receives a Neg-Raising interpretation.

This difference in defeasibility between *think* and *will* can be seen clearly in the continuations they can occur with, as in (255).

- (255) a. I don't think John is home...
- (i) ...because I don't have an opinion either way.
- b. John won't be home right now...
- (i) ...#because I don't have an opinion either way
  - (ii) ...#but he might be.

The continuations used in (255) are meant to explicitly contradict the Ex-Mid inferences. In (255a) the Ex-Mid of *think* is explicitly canceled or defused by the continuation, and *think*

receives a non-Neg-Raised reading. In (255b), neither continuation is acceptable. If the Ex-Mid of *will* could be canceled, it would receive a “not necessarily” ( $\neg\Box p$ ) reading, which should be compatible with a “possibly, possibly not” meaning, licensing the second ( $\Diamond p$ ) continuation.

We can compare the behavior of *will* with another universal epistemic modal *must*. Recall that epistemic *must* also scopes out of clause-mate negation, but it scopes under superordinate negation. Thus, (256a) can receive a “not necessarily” ( $\neg\Box p$ ) reading and is compatible with a “possibly” ( $\Diamond p$ ) continuation. This is not the case for *will*.

- (256) a. I don't think John must be home right now...  
(i) ...he might not be.  
b. I don't think John will be home right now...  
(i) ...#he might not be.

The continuation facts support the conclusion that the Ex-Mid of *will* is not defeasible, unlike the Ex-Mid for *think*.

### 6.2.1.2 Projection tests

The second difference between traditional NRPs and *will* comes from how the inferences behave in projection tests. Chapter 5 was devoted to showing that *will* always scopes outside of negation. This section tests the semantic status of the Ex-Mid by testing how it projects when the NRP is embedded under other truth-conditional operators: questions, antecedents of conditionals, and epistemic modals.

**Questions** As shown in (257), the Ex-Mid of *think* does not project outside of a question (as noticed by Gajewski 2007). (257) does not presuppose that Mary has an opinion about whether or not John is home.

- (257) Does Mary think that John is home right now?

In contrast, the Ex-Mid inference of *will* does project out of questions. First it is important to note that *will* displays the so-called “interrogative flip” observed with various speaker-oriented elements. The question in (258) asks about John being home relative to the addressee’s information/evidence, rather than the speaker’s.

(258) Will John be home right now?

- a. *Paraphrasable as:* Given that you know about John’s schedule/plans/normal behavior, is John home right now?
- b. *Not paraphrasable as:* Do you know if John’s schedule/plans/normal behavior are such that he is home right now?

The question in (258) presupposes that the addressee has information that allows her to conclude whether the prejacent holds or not. The question in (258) is naturally asked in a context where the addressee has access to John’s schedule or is presumed to know about his whereabouts. Comparing (258) with (257), intuitively, (257) asks if Mary has an opinion about John being home, whereas (258) assumes the addressee has some information/evidence that would allow her to conclude whether or not John should be home, and asks whether he is home or not.’

Below is more concrete evidence that the Ex-Mid of *will* does project out of questions. The first piece of evidence comes from what can be accepted or rejected using the polarity particles *yes* and *no*. (259) provides the *yes/no* responses with canonical continuations. In B’, the *no* answer indicates that the addressee has evidence that John is not in his office (maybe the addressee is his secretary or just knows his schedule).

- (259)
- a. A: Will John be in his office right now?
  - b. B: ✓Yes, he will be in his office right now.
  - c. B’: ✓No, he won’t be in his office right now.

Compare this with a question with *must*, as in (260). The *no* response to A's question in (260) means that it isn't necessary that John is in his office. In contrast, the *no* response to A's question in (259) means that it is necessary that John is not in his office.

(260) *Context: We have been debating whether John must be in office right now. We reevaluate the evidence and A asks:*

- a. A: Must John be in his office right now?
- b. B: ✓Yes, he must be in his office right now.
- c. B': ✓No, he might not be in his office right now.

In a Karttunen/Hamblin style semantics of questions (Hamblin 1973, Karttunen 1977), a polar question of the form  $p?$  denotes a proposition with two alternatives:  $p$ ,  $\neg p$ . Within the discourse model of Farkas and Bruce (2010), pragmatically, polar questions propose that one of these two propositions be added to the common ground. In the case of a polar question, two propositions are proposed: the proposition denoted by the TP (e.g., *that John will be in his office*) and its complement (e.g., *that John won't be in his office*). The assumption behind this test is that polarity particles can only be used to target these propositions (and not the presuppositions of the proposed propositions). An example of this is shown in (261) with a clear example of presupposition. That Lindsay has a sister is presupposed and cannot be rejected with *no*.

- (261)
- a. A: Is Lindsay's sister in town?
  - b. B: ✓No, Lindsay's sister isn't in town.
  - c. B': #No, Lindsay doesn't have a sister.

The response patterns in (259) can be compared with those in (262), modeled after Gunlogson (2008).

- (262)
- a. A: Will John be in his office right now?
  - b. B: I'm not in a position to settle that anymore than you are.

- c. B': #No, I'm not in a position to settle that anymore than you are.

The speaker can deny that she has information that settles the issue of the prejacent, but she cannot mark this denial with *no*. This suggests that this piece of meaning, that the speaker's information settles the prejacent (a.k.a the Ex-Mid), is not part of the at-issue content.

The second piece of evidence comes from which contexts a question with *will* can occur in. Consider the following three contexts (263)-(265).

(263) Off work context: *Bill works at the store, but today is his day off. Mary sees him around town and asks:*

- a. Will the store be busy right now?  
b. #Is the store busy right now?

(264) At work context: *Bill works at the store, and is currently answering the phones. A customer calls:*

- a. #Will the store be busy right now?  
b. Is the store busy right now?

(265) Tourist context: *Mary and Bill are on vacation and have just arrived in town. They read there is a store that is very popular and gets very busy. Mary asks Bill:*

- a. #Will the store be busy right now?  
b. #Is the store busy right now?  
c. Do you think the store is busy right now?  
d. Do you think the store will be busy right now?

In the off work context, Bill has knowledge of the store (presumably when it is usually busy or not) and Mary can ask the question in (263) with *will*, but not the unmodalized form. In the at work context, Bill has direct evidence for whether the store is busy; he is there. Mary can ask the unmodalized question in (264), but not the question with *will*. In the tourist context, Mary and Bill have the same information about the store's peak hours: not much at all. In

this context, it is inappropriate for Mary to ask the unmodalized question and the question with *will* in (265). She can, however, ask the form of the question with *think*. Note that the question can also be asked with *will* embedded under *think* in (265d). I'll return to this point in the discussion of how the Ex-Mid of *will* and *think* shifts when embedded.

**Epistemic Modals** The next test is for whether the meaning projects out of epistemic modals. First, as noticed by Gajewski (2007) and Romoli (2013), the excluded middle of *think* does not project out of epistemic modals. This is especially clear with possibility modals, as in (266b). (266b) and (266c) assert that it is possible/probable that Mary has an opinion about John being home; they do not presuppose that she does.

(266) PROJECTION OUT OF EPISTEMIC MODAL WITH *think*

- a. Mary must think that John is home.
- b. Mary might think that John is home.
- c. Mary probably thinks that John is home.

In contrast, the Ex-Mid of *will* does scope outside of some epistemic modals, as in (267). It is important to note that *will* is itself a modal, and modals can't generally co-occur in English. For example, *must/might* cannot occur with *will*. Given this, an epistemic adverb must be used for this test with *will*, as in (267). The sentence in (267) presupposes that the speaker has inferred John's whereabouts (e.g., knows his schedule) and that, relative to this information, it is probable that he is home. Crucially, (267) does not mean that it is probable that John's schedule settles that he is home.

(267) John will probably be home right now.

- a. *Paraphrasable as*: Given what I know about his schedule/plans/normal behavior, John is probably home.
- b. *Not paraphrasable as*: It is probable that I know John's schedule and it says he is home.

The Ex-Mid of *will* does not seem to project outside of all epistemic modals. For example, the sentences in (268) seem to pattern with *think*.

- (268) a. Maybe John will already be home by now.  
b. It might be the case that John will already be home by now.

The sentences in (268) do not presuppose that the speaker can infer whether John is home. The meaning of (268a) seems very similar to its unmodalized counterpart: *Maybe John is already home by now*. The two forms come apart when the prejacent contains an action that is not typically planned or predictable, as in (269).

- (269) Context: *Laura is always randomly taking naps throughout the day. I am complaining about this to a friend and I say..*  
a. Maybe she is taking a nap right now.  
b. ??Maybe she will be taking a nap right now.

(269) differs from (268a) in whether the prejacent denotes an eventuality that is likely to be planned or predictable. The use of *will* in (269) is odd not because the speaker cannot infer the truth of the prejacent but because it is in some sense not inferable. There is no plan or predictable habit for when she is napping.

This difference might be explained if the Ex-Mid of *will* projects out of *maybe* but is not necessarily anchored to the speaker. The Ex-Mid of (268) might be satisfied if there is a plan for John to be home or not, even if the speaker is not aware of that plan. The Ex-Mid of *will* in (269a) is unsatisfied because there is no plan or predictable behavior for Laura to be napping now. This suggests that the Ex-Mid of *will* does project outside of epistemic modals but isn't always anchored to the speaker.



**Antecedent of conditional** The final projection test is out of the antecedent of a conditional. As Gajewski (2007) points out, the Ex-Mid of *think* does not scope out of the antecedent of a counterfactual. This is shown in (270).

(270) If Mary thinks we should fire Dave, she should bring it up at the faculty meeting.

(270) does not presuppose that Mary has an opinion about whether Dave should be fired or not. As far as I can tell, epistemic *will* cannot occur in the antecedent of a conditional. The sentences in (271) are odd.

- (271) a. #If Mary will be at home right now, John won't go over there.  
b. #If John will be watching the kids, then Mary must be busy.

It seems that epistemic *will* simply can't occur in the antecedent of a conditional.<sup>2</sup>

### 6.2.1.3 Challengeability with *no*

The final test I will discuss is whether the Ex-Mid can be challenged directly using *no*, similarly to the question/response data discussed previously. The Ex-Mid inference of *think* can be directly challenged with *no*. This is shown in (272). In these examples, the NRP is embedded under *say* so that the challenge to the Ex-Mid is to a third party's evidence/knowledge. Confounds may be introduced when challenging the speaker on her own evidence/thoughts.

- (272) a. A: Mary said Hailey thinks John is home.  
b. B:No, he's not at home, I just saw him on campus.

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<sup>2</sup>There seem to be some antecedents that are marginally better with epistemic *will*, as in (i). Although, some speakers still reject (i) with *will*.

- (i) Context: Mary is looking at a schedule of what city each of the employees is in. Sue is in New York and needs someone who can help her. Bill knows that John can get the job done so he says:  
a. ?If John will be in New York right now, you should call him.

- c. B':No, she didn't say that.
- d. B'':No, Hailey doesn't have an opinion either way. Mary must have been talking to her twin, Sierra.

In (272), the B response rejects the most deeply embedded proposition *John is home*. The B' response rejects the highest clause: that Mary said that Hailey thinks John is home. Finally, the B'' response rejects the Ex-Mid of *think*: that Hailey has an opinion about John's whereabouts.

Three similar propositions could potentially be rejected with the *will* statement in (273).

- (273)
- a. A: Hailey said John will be home right now.
  - b. B: No, he isn't home yet, he called me a few minutes ago from campus.
  - c. B': No, she didn't say that.
  - d. B'': #No, Hailey thinks she knows John's schedule, but she doesn't.

Just like with (272), the most deeply embedded proposition is rejected with *no* in the B response, and the matrix proposition is rejected in B''. The Ex-Mid inference introduced by *will* cannot, however, be directly challenged with *no*, as shown in the B'' response in (273). There is a clear difference: *no* can be used to challenge the Ex-Mid of *think*, but not the Ex-Mid of *will*.

### 6.2.2 Interim summary

A summary of tests for the semantic status of the Excluded Middle for *think* and *will* is provided in Figure 6.1 below.

Figure 6.1: Summary of tests for semantic status

	Ex-Mid of NRP	Ex-Mid of <i>will</i>
Defeasibility	✓	✗
Challengeability with <i>no</i>	✓	✗
Projection out of..		
Negation	✓	✓
Questions	✗	✓
Antecedent of conditional	✗	—
Epistemic modals	✗	(✓)

The Ex-Mid inferences of *will* and *think* do not behave uniformly. The Ex-Mid inference of *think* does not behave like other presuppositions, as noticed by Gajewski (2005, 2007), Romoli (2012, 2013). It is defeasible, challengeable, and doesn't project out of truth-conditional operators. The surprising fact is that the Ex-Mid inference of *will* does behave like other presuppositions. It is not defeasible, it isn't directly challengeable, and it projects out of (some) truth-conditional operators. This suggests that there are two types of NRPs with Ex-Mid inferences that have different semantic status. The next section presents evidence that *will* really does behave like a NRP in other ways.

### 6.2.3 Properties shared by *will* and traditional NRPs

This section discusses some ways that traditional Neg-Raising Predicates (NRPs) and *will* behave alike. Specifically, it examines the licensing of strict Negative Polarity Items (NPIs) and the cyclic Neg-Raising patterns, briefly discussed in Chapter 5.

### 6.2.3.1 Strict NPI licensing

One grammatical phenomenon that seems to be sensitive to Neg-Raising is the licensing of “strict” Negative Polarity Items (NPIs). Negated NRPs license strict NPIs, such as *in years* and punctual *until* in the subordinate clause, while non-NRPs do not. This is shown in (274) and (275).

- (274) LICENSING OF STRICT NPI *in +indefinite amount of time*
- a. #John isn’t certain that Bill has seen Mary in years.
  - b. John doesn’t think that Bill has seen Mary in years.

- (275) LICENSING OF STRICT NPI *punctual until*
- a. #John isn’t certain that Bill left until yesterday.
  - b. John doesn’t think Bill left until yesterday.

This behavior is mirrored in *will*. *Will* licenses strict NPIs in its preadjacent when negated. This is shown in (276). Notice that negated *have to*, which is not a NRP, does not license strict NPIs in its embedded clause.

- (276) LICENSING OF STRICT NPI *in ages* WITH MODALS
- a. #John doesn’t have to have seen Mary in years.
  - b. John won’t have seen Mary in years.

While the contrast in licensing of *in years* is quite clear between (276b) and (276a), the contrast is less clear with punctual *until*.

- (277) LICENSING OF STRICT NPI *punctual until* WITH MODALS
- a. ?John won’t have talked to Mary until yesterday.
  - b. #John didn’t have to have talked to Mary until yesterday.

This may just be due to a clash with the temporal reference of *until yesterday*. The sentence with *will* is greatly improved when the temporal reference on the NPI corresponds with the utterance time, as in *until just now*, as in (278).

- (278) a. John won't have talked to Mary until just now.  
 b. #John didn't have to have talked to Mary until just now.

In conclusion, just as traditional NRPs license strict NPIs in their embedded clause, *will* licenses strict NPIs in its prejacent.

### 6.2.3.2 Cyclicity

Fillmore (1963) observed that Neg-Raising could occur cyclicly, as in (279a). This was briefly discussed in Chapter 5.

- (279) CYCLIC NEG-RAISING WITH TRADITIONAL NRPS
- a. John doesn't think Mary wants to swim.  
 (i) *Paraphrasable as*: John thinks that Mary wants to not swim.  
 $\checkmark$  THINK > WANT > NEG
- b. John doesn't want Mary to think he is swimming.  
 (i) *Not paraphrasable as*: John wants Mary to think he is not swimming.  
 $\times$  WANT > THINK > NEG

Both *think* and *want* are NRPs. When *want* is embedded under *don't think*, the Neg-Raising is said to be cyclic because the negation is interpreted in the most embedded clause—under *want*. Horn (1978) pointed out that while Neg-Raising does occur cyclically in some some configurations of stacked NRPs, as seen in (279a), it doesn't occur with all configurations of stacked NRPs. For example, the configuration of *think* embedded under *don't want* does not give rise to a cyclic interpretation, as in (279b). The generalization typically taken from these facts is that cyclicity is blocked when a bouletic NRP embeds a doxastic one.

Both the presuppositional analysis of Gajewski and the scalar implicature analysis of Romoli provide an explanation for the lack of cyclicity in (279b), although Gajewski's analysis may be more natural. Kriz (2015), however, disputes this empirical generalization. He claims that there are cases of cyclic Neg-Raising with a bouletic NRP embedding a doxastic one. His examples are given in (280).

(280) KRIZ'S (2015) EXAMPLES OF CYCLICITY WITH BOULETIC > DOXASTIC NRPS

- a. I don't want John to think that Harry will arrive until next week.
- b. I don't want you to believe that I'll lift a finger to help you.
- c. Adam had had trouble at customs, and Agatha didn't want her friends to think that she had got through unmolested either.

In these sentences, a strict NPI occurs in the most embedded clause. If this NPI is licensed, then Neg-Raising must have happened cyclicly. Given these data, it is unclear if it is even desirable that a theory predict the difference in cyclicity between (279a) and (279b).

*Will* shows full cyclicity with all types of NRPs. (281a) and (281b) show that *will* participates in cyclic Neg-Raising with *think*, in both possible configurations. This can be contrasted with *have to* which is not a NRP and thus does not participate in cyclic Neg-Raising, as shown in (281c) and (281d).

(281) CYCLIC NEG-RAISING WITH DOXASTIC NRP AND *will*

- a. John doesn't think Mary will be swimming.
  - (i) THINK > WILL > NEG
- b. John won't think Mary is swimming.
  - (i) WILL > THINK > NEG
- c. John doesn't think Mary has to be swimming.
  - (i) THINK > NEG > HAVE TO
- d. John doesn't have to think Mary is swimming.
  - (i) NEG > HAVE TO > THINK

To confirm that Neg-Raising is indeed applying cyclically, a few things can be done. First, the contexts they can be used in make clear that the negation is being interpreted in the lowest clause with *will* (281a)-(281b) but not with *think* (281c)-(281d). Consider the context in (282).

(282) *Context: John and Mary are small children. John will be very jealous if there is even a possibility that Mary is swimming without him. Mary's mom has taken her swimming, but now Mary is nervous that John will be jealous. But Mom knows that John expects the kids to be doing homework right now. Mom says: Don't worry John won't be jealous...*

- a. he doesn't think you will be swimming right now.
- b. he won't think you're swimming right now.
- c. #he doesn't think you have to be swimming right now.
- d. #he doesn't have to think you're swimming right now.

In this context, if John believes there was even a possibility that Mary was swimming, he would be jealous. (282a)-(282b) assure Mary that John doesn't think she is swimming, but (282c)-(282d) with a non-NRP do not.

The second piece of evidence comes from the licensing of strict NPIs. In (283a) and (283b), the strict NPI *in years* is licensed, but in (283c) and (283d) with a non-NRP, the NPI is not licensed.

(283) LICENSING OF NPI *in years* WITH NRP + MODAL

- a. I don't think John will have seen Mary in years.
- b. Bill won't think that John has seen Mary in years.
- c. \*I don't think John had to have seen Mary in years.
- d. \*John doesn't have to think Mary has seen Bill in years.

*Will* also shows cyclic Neg-Raising with bouletic NRPs, as in (284). Since *will* can only occur in finite clauses, and *want* only embeds non-finite clauses, *will* cannot be embedded under *want*. The only possible configuration is *will* embedding *want*, and this configuration does show cyclic Neg-Raising, unlike *have to*. This is shown in (284) and confirmed by the strict NPI data in (285).

(284) CYCLIC NEG-RAISING WITH BOULETIC NRP AND *will*

- a. John won't want Mary to be swimming.
  - (i) WILL > WANT > NEG
- b. John doesn't have to want Mary to be swimming.
  - (i) NEG > HAVE TO > WANT

(285) LICENSING OF *in ages* WITH BOULETIC NRP AND *will*

- a. John won't want Mary to have seen Bill in years/until yesterday.
  - (i) WILL > WANT > NEG
- b. \*John doesn't have to want Mary to have seen Bill in years/until yesterday.
- c. NEG > HAVE TO > WANT

For all of the configurations of *will* stacked with other NRPs, we see full cyclicity. *Will* is never interpreted in the scope of negation.

#### 6.2.4 Interim summary

This section showed that the Ex-Mid inference of *will* behaves differently than that of traditional NRPs (§6.2.1). The Ex-Mid of *will* behaves like a presupposition: it projects out of truth-conditional operators, it is not defeasible, and cannot be directly challenged. In contrast, the Ex-Mid inference of traditional NRPs, in some ways, does not behave like a presupposition: it doesn't project out of truth-conditional operators, it is defeasible, and can directly be challenged. With respect to cyclicity and licensing of strict NPI, however, traditional NRPs and *will* show the same behavior (§6.2.3). Ideally, an analysis would predict the difference in



semantic status, but would also account for the uniformity in cyclicity and NPI licensing. In the following section, I will adopt Gajewski's (2005) presuppositional analysis for *will*. I will leave open how exactly traditional NRPs should be analyzed. For simplicity, I assume the same presuppositional analysis for traditional NRPs. Some analysis must be used to show how cyclic Neg-Raising might occur between *will* and traditional NRPs.

### 6.3 Proposal for *will*

*Will* shows very unique behavior in its interaction with negation. In fact, it is used in many examples in the Neg-Raising literature, and yet it is never discussed how *will* scopes relative to negation. The discussion of the sentences in (286) are parallel, and *will* is assumed to just be another tense.

- (286) a. John doesn't think Mary will be home.  
b. John doesn't think Mary was home.

*Will* is even unique relative to other universals that are typically interpreted outside the scope of negation. Chapter 5 showed that epistemic *must* outscopes clause-mate negation, but there are environments where it is interpreted in the scope of negation (e.g., superordinate negation). This chapter showed another way that a universal can interact with negation: Neg-Raising. While a traditional NRP like *think* is generally interpreted above negation (analyzed here as an Ex-Mid inference), there are specific environments where it is not. *Will* is never interpreted in the scope of negation. Consider (287). Small caps are used to notate some type of emphasis or focus on the lexical item.

- (287) a. It's not the case that John MUST be home right now.  
b. John doesn't THINK Mary is home right now.  
c. ??It's not the case that John WILL be home right now.

In (287), intonation is used to explicitly target *must*, *think*, and *will*. It completely fails with *will*. In some sense, *will* seems to never show its universal force. With respect to negation, sentences with *will* are interpreted as if *will* were not a universal modal.

This section proposes an analysis of *will* that accounts for all of the properties observed for *will* in this portion of the dissertation, summarized in (288).

(288) DESIDERATA FOR PART II:

- a. *Will* is never interpreted in the scope of negation.
- b. *Will* displays the interrogative flip and shifts under attitude predicates.
- c. *Will* participates in cyclic Neg-Raising with both *think* and *want*.
- d. Strict NPIs are licensed in the scope of negated *will*.

The analysis proposed here also explains why *will* appears to lack quantificational force, and in effect looks like a tense, while still maintaining that it is a universal modal. The analysis has a few ingredients. First, I propose that *will* carries an Excluded Middle presupposition, as in (289) repeated from (252).

(289) EXCLUDED MIDDLE FOR *will*:

$\llbracket \text{will } \varphi \rrbracket^{w,c,f}$  is defined only if

$$\forall w' \in \bigcap f_{\text{epis}}(w) : [\llbracket \varphi \rrbracket^{w',c,f} = 1] \vee \forall w' \in \bigcap f_{\text{epis}}(w) : [\llbracket \varphi \rrbracket^{w',c,f} = 0]$$

Recall, from Chapter 4, that I take an epistemic modal base to be worlds compatible with some body of evidence (von Stechow and Gillies 2010, Kratzer 2012, Matthewson 2015). (289) states that the prejacent is true in all worlds compatible with some body of evidence. The worlds in the epistemic modal base are either all  $p$  worlds or all  $\neg p$  worlds.

The second ingredient of the analysis is concerned with what the epistemic modal is anchored to. Stephenson (2007), among others, has observed that epistemic modals shift under attitude predicates. This is shown in (290a) for *might* and in (290b) for *will*.

- (290) a. John thinks Mary might be home, but I know she isn't  
 b. John thinks Mary will be home (right now), but I know she isn't.

In (290a), Mary being home is possible relative to John's beliefs, not the speaker's. Stephenson (2007) analyzes this phenomenon using a judge parameter and centered worlds. In simplistic terms, the embedded modal is not evaluated relative to the speaker and the actual world, but instead relative to John and his belief worlds. Notice that this same shift happens with attitude predicates embedded under modals, as in (291). Each modal/attitude predicate is evaluated relative to the modal/attitude predicate the embeds it.

- (291) (*Kaeli saw Dan at the doctor, and now*) Laura thinks Kaeli might think Dan is sick, but I know Kaeli doesn't think that.

(291) doesn't claim that it is possible in the actual world that Kaeli thinks Dan is sick; rather, it claims that it is possible relative to Laura's epistemic worlds that Kaeli thinks that. This shows that modals shift the world of evaluation for attitude predicates, just like attitude predicates shift the world of evaluation for modals.

For this reason, as well as the interrogative flip data discussed in Section 6.2.1, I follow Stephenson (2007) in analyzing epistemic modals as anchored to a judge and world of evaluation.<sup>3</sup> This gives us the definitions below in (292). In derivations, I will use the abbreviation in (292b).

- (292) EPISTEMIC MODALITY WITH JUDGES
- a.  $f_{epis}(w, j)$  = a set of facts known to  $j$  in  $w$   
 b.  $\bigcap f_{epis}(w, j) = \text{EPI}_{w,j}$

I will assume that expressions are evaluated relative to a context which is (minimally) a world, judge pair  $\langle w, j \rangle$ , notated as  $c;w,j$ . For simplicity, I will not use centered worlds. Instead,

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<sup>3</sup>For simplicity, I ignore the issue of self-ascription here.

the modal or attitude predicate is evaluated relative to the shifted world and judge, including its presuppositions. This gives us the following denotation for *will*.

(293) DENOTATION FOR EPISTEMIC *will*

- a.  $\llbracket \textit{will}\text{-}\varphi \rrbracket^{c;w,j}$  is defined only if  
 $\forall w' \in \bigcap f_{epist}(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 1] \vee \forall w' \in \bigcap f_{epist}(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 0]$
- b. If defined,  $\llbracket \textit{will}\text{-}\varphi \rrbracket^{c;w,j} = 1$  iff  $\forall w' \in \bigcap f_{epist}(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 1]$

The asserted content of *will* in (293) is that of a typical epistemic modal, similar to *must*. The Ex-Mid presupposition, however, is not uniform across all epistemic modals, and specifically it is not shared with *must*. In Section 6.5, I will argue that future uses of *will* also carry the Ex-Mid presupposition. In Chapter 7, I will argue that all uses of *will* carry an Ex-Mid presupposition. Thus, the denotation for (293) can be generalized to not only hold for epistemic uses of *will*, as in (294).

(294) GENERALIZED DENOTATION FOR *will*

- a.  $\llbracket \textit{will}\text{-}\varphi \rrbracket^{c;w,j}$  is defined only if  
 $\forall w' \in \bigcap f(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 1] \vee \forall w' \in \bigcap f(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 0]$
- b. If defined,  $\llbracket \textit{will}\text{-}\varphi \rrbracket^{c;w,j} = 1$  iff  $\forall w' \in \bigcap f(w, j) : [\llbracket \varphi \rrbracket^{c;w',j} = 1]$

In this analysis, *will* is treated as a universal modal which is compatible with multiple conversational backgrounds—possibly epistemic and metaphysical as Condoravdi (2002) claims (see Chart of flavors of *will* in Chapter 2)—but regardless of the precise flavor of the conversational background, it always carries an Ex-Mid presupposition.

In sum, the presupposition of *will* directly encodes the Ex-Mid inference deriving the Neg-Raising behavior (Desideratum b). The anchoring of the modal base to a judge and world of evaluation, which is independently motivated by Stephenson (2007), is used to account for the behavior of embeddings of epistemic modals in general (Desideratum c). The rest of this subsection will be devoted to providing simple examples (§6.3.1) and my assumptions about

the semantics of attitude predicates (§6.3.2). Section 6.3.3 will then show how the cyclicity and strict NPI licensing (Desideratum d) is accounted for by the analysis proposed here.

### 6.3.1 Simple examples with *will* and negation

The proposed presupposition for *will* is simply the presuppositional Ex-Mid proposed by Gajewski (2005) for traditional NRPs extended to a universal epistemic modal. In affirmative assertions, such as *Mary will be home*, the Ex-Mid presupposition does not do any work because the assertion entails the presupposition.

When *will* is unembedded, I assume it is evaluated relative to the actual world (notated as @) and the judge is set to the speaker (notated as *s*), as in (295).

(295) Mary will be home.

- a.  $\llbracket (295) \rrbracket^{c;@,s}$  is defined only if  $\forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 1] \vee \forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 0]$
- b. If defined,  $\llbracket (295) \rrbracket^{c;@,s} = 1$  iff  $\forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 1]$

The Ex-Mid presupposition of *will* has the same effect in negative assertions as discussed previously for traditional NRPs, as in (296). The Ex-Mid presupposes that all of the worlds in the speaker's epistemic modal base are either all worlds where Mary is home or all worlds where Mary is not home. (296) asserts that not all of the worlds in the speaker's epistemic modal base are worlds where Mary is home. The assertion and the presupposition taken together entail that all the worlds in the speaker's epistemic modal base are worlds where Mary is not home.

(296) Mary won't be home.

- a.  $\llbracket (296) \rrbracket^{c;@,s}$  is defined only if  $\forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 1] \vee \forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 0]$
- b. If defined,  $\llbracket (296) \rrbracket^{c;@,s} = 1$  iff  $\neg \forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 1]$

- c. a + b entails:  $\forall w' \in EPI_{@,s} : [\llbracket \text{Mary-be-home} \rrbracket^{c;w',s} = 0]$

(296) asserts that not all of the worlds compatible with the speaker's epistemic state in the actual world are ones in which Mary is home. The presupposition, however, requires that the epistemic modal base be settled with respect to whether Mary is home. It requires that the speaker's evidence in the actual world either supports that Mary is home or supports that she is not home. If it's not the case that all worlds in the epistemic modal base are ones in which Mary is home, but the modal base is necessarily decided on this matter, then it must be the case that all the worlds are ones where Mary is not home.

### 6.3.2 Assumptions about semantics of attitude predicates

In discussing the cyclicity between *will* and traditional NRPs and the NPI licensing facts, it will be necessary to have an analysis of traditional NRPs. I will assume a Hintikka-style semantics for attitude predicates, as in (297).

- (297) a.  $\llbracket \text{think } \varphi \rrbracket^{c;w,j} = \lambda x. \forall w' \in DOX_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1]$   
 b.  $\llbracket \text{want } \varphi \rrbracket^{c;w,j} = \lambda x. \forall w' \in BOUL_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1]$

Definitions for doxastic and bouletic alternatives are given below. I have left out the temporal argument for simplicity.

- (298) a.  $DOX_{w,x} = \{w' : w' \text{ is compatible with what } x \text{ believes in } w \}$   
 b.  $BOUL_{w,x} = \{w' : w' \text{ is compatible with what } x \text{ desires in } w \}$

I will follow Gajewski (2005) in assuming that these predicates carry an Excluded Middle presupposition, as in (299).

- (299) (297) + Ex-Mid presupposition

- a.  $\llbracket \textit{think } \varphi \rrbracket^{c;w,j} = \lambda x : [\forall w' \in DOX_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1] \vee \forall w' \in DOX_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 0]] . \forall w' \in DOX_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1]$
- b.  $\llbracket \textit{want } \varphi \rrbracket^{c;w,j} = \lambda x : [\forall w' \in BOUL_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1] \vee \forall w' \in BOUL_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 0]] . \forall w' \in BOUL_{w,x} : [\llbracket \varphi \rrbracket^{c;w',x} = 1]$

Notice that this gives the Ex-Mid inference of *will* and traditional NRPs the same semantic status—an undesirable fact. Given that each of the proposed analyses for traditional NRPs have drawbacks, I will simply assume a presuppositional account for all NRPs.

If *think* or *want* is embedded under an epistemic modal, such as *will* or *might*, the judge and world of evaluation are shifted. The shift in judge does not make a difference for the attitude predicates. An example is given in (300).

(300) Mary will think Bill is home.

(300) asserts that all of the speaker's epistemic worlds are such that Mary's belief worlds (in the speaker's epistemic worlds) are worlds in which Bill is home. It might not be the case that all of Mary's belief worlds in the actual world are ones where Bill is home. That is, the doxastic worlds are shifted to be those accessible from the speaker's epistemic worlds, rather than the actual world. This is shown below in (301).

(301)  $\llbracket \llbracket \textit{will} [\textit{Mary} [\textit{think} [\varphi]]] \rrbracket \rrbracket^{c;@,s}$

a. is defined only if

(i)  $\forall w' \in EPI_{@,s} : [\forall w'' \in DOX_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]] \vee$

$\forall w' \in EPI_{@,s} : [\neg \forall w'' \in DOX_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]],$  and

(ii)  $\forall w' \in EPI_{@,s} : [\forall w'' \in DOX_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1] \vee \forall w'' \in DOX_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 0]]$

b. If defined,  $\llbracket (301) \rrbracket^{c;@,s} = 1$  iff  $\forall w' \in EPI_{@,s} : [\forall w'' \in DOX_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]]$

As discussed for the simple cases in Section 6.3.1, in an affirmative assertion, such as the one in (300), the presuppositions of *will* and *think* don't do much. Note, however, that the presuppositions are also shifted in their judge and world of evaluation.

If a modal is embedded under an attitude predicate, as in (302), the modal's judge and world of evaluation are shifted.

(302) Mary thinks Bill will be home.

(302) asserts that all of Mary's epistemic worlds accessible from her belief worlds in the actual world are ones in which Bill is home. In this case, *think* and *will* are both evaluated relative to *Mary*.

(303)  $\llbracket \llbracket \text{Mary think } [\text{will } [\varphi]] \rrbracket \rrbracket^{c;@,s}$

a. is defined only if

(i)  $\forall w' \in DOX_{@,m} : [\forall w'' \in EPI_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1] \vee \forall w'' \in EPI_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 0]]$

(ii)  $\forall w' \in DOX_{@,m} : [\forall w'' \in EPI_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]] \vee \forall w' \in DOX_{@,m} : [\neg \forall w'' \in EPI_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]]$

b. If defined  $\llbracket (303) \rrbracket^{c;@,s} = 1$  iff  $\forall w' \in DOX_{@,m} : [\forall w'' \in EPI_{w',m} : [\llbracket \varphi \rrbracket^{c;w'',m} = 1]]$

Again, the presuppositions don't do much work in the affirmative assertions. It is important to notice though that the epistemic modal base is evaluated relative to Mary and her doxastic worlds. While the Ex-Mid does project, it is not speaker-oriented. This accounts for the fact that (302) could occur with continuations such as *...but she won't be* (relative to the speaker's epistemic state in the actual world, Mary is not home). The next section will focus on negated sentences in which the presuppositions derive the Neg-Raising behavior.



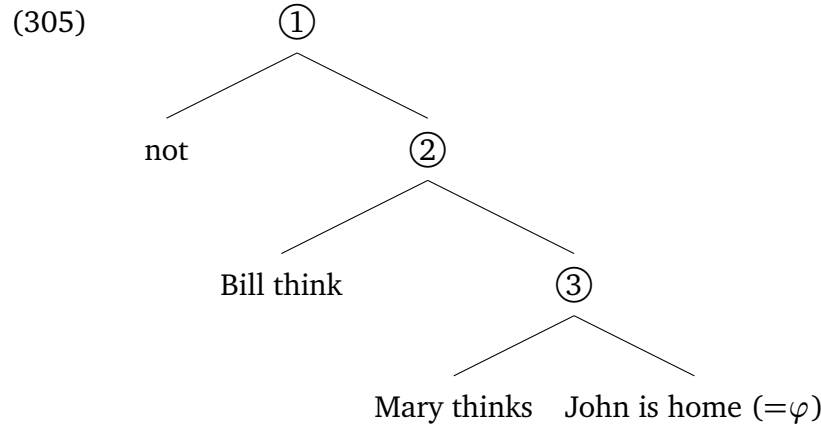
### 6.3.3 Cyclicity and NPI licensing

#### 6.3.3.1 Cyclicity

Fillmore (1963) used cyclicity as an argument for a syntactic treatment of Neg-Raising. Gajewski (2005, 2007) showed, however, that a semantic treatment could also predict the Neg-Raising behavior. First I will discuss how the presuppositional theory of Neg-Raising can predict cyclicity. Then I will discuss how Gajewski (2005) accounts for cases of partial cyclicity.

If we assume that attitude predicates and modals shift their world of evaluation when embedded, complete cyclicity of any configuration of NRPs is predicted. Consider the case below of consecutive *thinks*. These formulas can be a bit much to read, so I have provided a simplified version in (309).

(304) Bill doesn't think Mary thinks John is home.



(306) ③

- a. TC:  $\lambda w. \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]$
- b. P<sub>1</sub>:  $\lambda w. \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1] \vee \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 0]$

(307) ②

- a. TC:  $\forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]]$
- b. P<sub>1</sub>:  $\forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1] \vee \forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 0]]$

- c.  $P_2: \forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [[\varphi]]^{c;w',m} = 1]] \vee$   
 $\forall w'' \in \text{DOX}_{@,b} : [\neg \forall w' \in \text{DOX}_{w'',m} : [[\varphi]]^{c;w',m} = 1]]$

(308) ① TC:  $\neg \forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{m,w''} : [[\varphi]]^{c;w',m} = 1]]$

(309) ① *simplified*

- a. TC:  $\neg \text{think}_b(\text{think}_m(p))$   
b.  $P_1: \text{think}_m(p) \vee \text{think}_m(\neg p)$   
c.  $P_2: \text{think}_b(\text{think}_m(p) \vee \text{think}_b(\neg \text{think}_m(p)))$

In simplified terms, (304) asserts  $\neg \text{think}_b(\text{think}_m(p))$  with negation in the highest position, and the interpretation with complete cyclicity is  $\text{think}_b(\text{think}_m(\neg p))$  with negation in the lowest position. This is achieved through a series of entailments when the assertion and presuppositions are taken together, as is done in the simple cases. I'll now go through each of the entailments step by step.

The presupposition projected from the matrix *think*,  $P_2$ , requires that all Bill's belief worlds in the actual world are ones in which Mary thinks John is home, or none are ones where she thinks John is home. The assertion contradicts the first disjunct: not all of Bill's belief worlds are ones in which Mary thinks John is home. Thus, the second disjunct of  $P_2$  must hold, as in (310). This entailment in simplified terms is  $\text{think}_b(\neg \text{think}_m(p))$ .

(310) TC +  $P_2 = \forall w'' \in \text{DOX}_{@,b} : [\neg \forall w' \in \text{DOX}_{w'',m} : [[\varphi]]^{c;w',m} = 1]]$

The presupposition projected from the embedded *think*,  $P_1$ , requires that all worlds compatible with Mary's beliefs in Bill's belief worlds are either all worlds where John is home or all ones where John is not home. Notice that these are Mary's beliefs relative to Bill's beliefs and not necessarily Mary's beliefs in the actual world. The entailment in (310) contradicts the first disjunct of  $P_1$ , and therefore together the assertion and (310) entail that all of Mary's belief worlds (according to Bill) are ones in which John is not home. The entailment in (311) in simplified terms is  $\text{think}_b(\text{think}_m(\neg p))$ .

$$(311) \quad (310) + P_2 = \forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [[\varphi]]^{c;w',m} = 0]]$$

The complete cyclicity is derived for: in (304) the negation is in the highest position, and the interpretation in (311) has the negation below both of the NRPs. Thus, complete cyclicity falls out naturally under an analysis of presupposition projection in which attitude predicates are shifted when embedded. This may or may not be desirable depending on the data, whether complete cyclicity always occurs.

Recall from Section 6.2.3.2 that Horn (1978) claims that certain configurations of stacked NRPs are not interpreted with complete cyclicity; there is only partial cyclicity when a bouletic NRP embeds a doxastic one. To account for this fact, Gajewski (2005) draws on the fact that in general the presuppositions of bouletic predicates project through the subject's beliefs, rather than desires (Karttunen 1974, Heim 1992). This is shown in examples (312) and (313) below.

(312) Bill thinks he will sell his cello.

Presupposition: Bill thinks he has a cello.

(313) Bill wants to sell his cello.

Presupposition: Bill thinks he has a cello.

(Not: Bill wants to have a cello.)

The presupposition from “his cello”, *that Bill has a cello*, is interpreted relative to Bill's beliefs, not his desires.

Gajewski (2007) adopts a theory of presupposition projection from Karttunen and Peters 1979.<sup>4</sup> In Karttunen and Peter's system, constituents denote ordered pairs. The first member is its extension, and the second is its presuppositions (for them, a conventional implicature). The rule for composing these objects is given in (314).

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<sup>4</sup>In an appendix, Gajewski gives another formulation in which presuppositions are modeled as definedness conditions. I only present this formulation for ease of exposition.

(314) K&P FUNCTION APPLICATION

$$\langle \alpha, \beta \rangle \langle \gamma, \delta \rangle = \langle \alpha(\gamma), \beta(\gamma) \wedge h(\alpha, \gamma) \rangle$$

Informally, in K&P function application, the asserted content of the two elements (function and argument) compose typically through Function Application (FA); this is the first item of the ordered pair. The second item is concerned with how the presuppositions of each of the elements being composed (function and argument) are adopted by the result of FA: the output.

The heritage function can be specified for how a lexical item adopts the presuppositions of the elements it embeds (takes as an argument). For attitude predicates, Gajewski (2007) provides the heritage rule in (i).<sup>5</sup>

(315) When  $\alpha$  is an attitude predicate,

$$h(\alpha, \gamma) = \lambda w \lambda x. \forall w' \in \text{DOX}_{w,x} : [\llbracket \gamma \rrbracket^{c;w',x} = 1]$$

If a presupposition is introduced underneath an attitude predicate (as we saw with “his cello”) the presupposition is interpreted relative to the attitude holder’s doxastic state, regardless of whether the attitude predicate is itself doxastic.

Returning to the Neg-Raising data, the heritage rule makes the presuppositions of Neg-Raising predicates all project as a requirement on the subject’s doxastic alternatives, even if the NRP is bouletic, as in (316).

(316) Bill doesn’t want Mary to think John is home.

The work of the heritage rule is found in how presupposition projected from *think*,  $P_2$ , is adopted by the higher attitude predicate. Rather than the Mary’s belief worlds being presup-

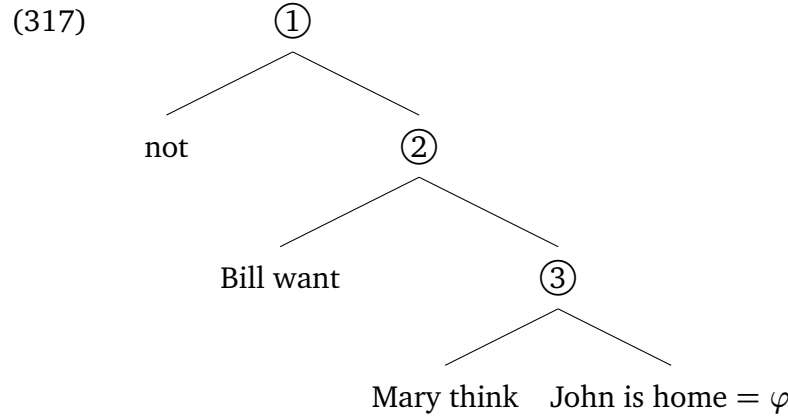
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<sup>5</sup>The actual heritage function from Gajewski (2007) is given in (i).

(i) When  $\alpha$  is an attitude predicate,

$$h(\alpha, \gamma) = \lambda x. B_x \subseteq \{u: \gamma(u)=1\}$$

posed to be settled (Ex-Mid presupposition) in Bill's desire worlds, they are presupposed to be settled in his belief worlds. This is found in P<sub>2</sub>.



- (318) ③
- a. TC:  $\lambda w. \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]$
  - b. P<sub>2</sub>:  $\lambda w. \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1] \vee \forall w' \in \text{DOX}_{w,m} : [\llbracket \varphi \rrbracket^{c;w',m} = 0]$

- (319) ②
- a. TC:  $\forall w'' \in \text{BOUL}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]]$
  - b. P<sub>1</sub>:  $\forall w'' \in \text{BOUL}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]] \vee \forall w'' \in \text{BOUL}_{@,b} : [\neg \forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]]$
  - c. P<sub>2</sub>:  $\forall w'' \in \text{DOX}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1] \vee \forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 0]]$

- (320) ① TC:  $\neg \forall w'' \in \text{BOUL}_{@,b} : [\forall w' \in \text{DOX}_{w'',m} : [\llbracket \varphi \rrbracket^{c;w',m} = 1]]$

A simplified version is provided below in (321).

- (321) *Simplified*
- a. TC:  $\neg \text{want}_b(\text{think}_m(p))$
  - b. P<sub>1</sub>:  $\text{want}_b(\text{think}_m(p)) \vee \text{want}_b(\neg \text{think}_m(p))$
  - c. P<sub>2</sub>:  $\text{think}_b(\text{think}_m(p) \vee \text{think}_m(\neg p))$

The complete cyclicity is blocked for this configuration by the heritage rule. It is possible for Bill to believe that Mary's belief worlds are settled with respect to John being home (simplified form in (321c)) but not want them to be settled. The assertion and  $P_1$  entail that all of Bill's desire worlds are ones in which its not the case that all Mary's belief worlds are ones in which John is home (simplified form in (322)).

(322)  $\text{want}_b(\neg\text{think}_m(p))$

The final step of cyclicity, however, is blocked because (322) does not contradict either disjuncts in (321c).

Gajewski's (2007) theory predicts full cyclicity with *think*>*want* but only partial cyclicity with *want*>*think*. The prediction is actually much more broad: cyclicity is blocked anytime there are stacked attitude predicate NRPs and the higher NRP attitude predicate is not doxastic. As discussed in Section 6.2.3.2, Kriz (2015) provides data in which cyclicity is not blocked in these cases. I leave as an open question whether the cyclicity facts are more nuanced than Gajewski and others take them to be.

Recall the cyclicity data discussed above for *will*, repeated in (323). Given that *will* carries an Ex-Mid presupposition, like *want* and *think*, complete cyclicity is predicted in all of these cases.

- (323) a. Mary won't think Bill arrived home until yesterday.  
       (i) WILL > THINK > NEG
- b. Mary doesn't think Bill will have seen John in years.  
       (i) THINK > WILL > NEG
- c. Mary won't want Bill to arrive home until next week.  
       (i) WILL > WANT > NEG

Gajewski's (2007) theory does predict full cyclicity in all these cases. It only predicts that cyclicity would be blocked if a non-doxastic attitude predicate embedded *will*. Some such NRP

is *want*, but *want* cannot embed *will* because it only takes non-finite complements and *will* can only occur in finite clauses.

### 6.3.3.2 NPI Licensing

Recall that strict NPIs are licensed in the most deeply embedded clause of stacked *will* with traditional NRPs. The relevant examples are repeated below in (324).

- (324)
- a. Mary won't think Bill arrived home until yesterday.
    - (i) WILL > THINK > NEG
  - b. Mary doesn't think Bill will have seen John in years.
    - (i) THINK > WILL > NEG
  - c. Mary won't want Bill to arrive home until next week.
    - (i) WILL > WANT > NEG

Notice that strict NPIs are not licensed in the lowest clause when *will* is stacked with non-NRPs such as *be certain*. This is shown in (325).

- (325)
- a. Mary won't be certain Bill arrived home until tomorrow.
    - (i) WILL > NEG > be CERTAIN
  - b. \*Mary won't be certain Bill arrived home until yesterday.
    - (i) WILL > NEG > be CERTAIN
  - c. \*Mary isn't certain Bill will have seen John in years.
    - (i) NEG > be CERTAIN > WILL

Notice that (325a) is grammatical, but only on a reading where the NPI *until tomorrow* is interpreted as the time of not being certain, not the time of Bill arriving home. This can be shown by the ungrammaticality of (325b), where the NPI *until yesterday* cannot modify the time of being certain due to a temporal clash between *will* and *yesterday*. In this sentence,

the NPI can only be interpreted as modifying the time of arriving—the most deeply embedded clause—and the NPI is not licensed in that position.

I assume following Gajewski (2005, 2007), following Zwarts 1996, that Strict NPIs are licensed in Anti-Additive environments, as defined below.

(326) F is Anti-Additive iff  $F(A \vee B) \Leftrightarrow F(A) \wedge F(B)$

Gajewski (2005, 2007) shows that the following environments have the following monotonicity properties.

- (327)
- a. EVERY(EVERY(NOT\_)) is Anti-Additive
  - b. EVERY(NOT(EVERY\_)) is not Anti-Additive
  - c. NOT(EVERY(EVERY(\_))) is not Anti-Additive

With respect to stacked (universal) predicates and modals, we expect to find strict NPIs licensed in the most deeply embedded clause only if there is full cyclicity, giving rise to the interpretation in (327a). This predicts that the Strict NPIs are licensed in (324) but not in (325). And this is in fact what we find.

## 6.4 Inferenceals as variable force modals

There have been previous analyses of present inference uses of future markers—what are called “inferenceals”—in Romanian (Mihoc 2012), Spanish (Rivero 2014), and Bulgarian (Rivero and Simeonova 2014). These authors have argued that inferenceals are not universal modals, but are instead variable force modals. They adopt Kratzer’s (2012) analysis of “variable-force upper-end degree modals” (Kratzer 2012, p. 46). Rather than encoding the familiar universal or existential force, the force of these modals is variable in context and can be paraphrased as “(somewhat) probably or (somewhat) desirable” (p. 47).



Section 6.4.1 provides a very brief overview of variable force modals and previous analyses of them. Section 6.4.2 discusses the evidence provided by Mihoc (2012), Rivero (2014), Rivero and Simeonova (2014) for inferentials receiving a variable force analysis. This section argues that a more systematic cross-linguistic comparison of these inferentials is needed. Section 6.4.3 discusses the possibility that English *will* should be analyzed as variable force.

#### 6.4.1 Previous analyses of variable force modals

Variable force modals were first described by Rullmann, Matthewson, and Davis (2008) for modals in a Salish language St'át'imcets. Modals in this language do not have the familiar Indo-European duals: necessity and possibility. Instead, these modals can receive either universal or epistemic modals depending on the context. Rullmann et al. (2008) provide an extensive description of these modals and their context dependency. Here I will only briefly mention a few empirical points. The interested reader is referred to the original source.

The first fact is that these modals can be translated into English as either *must* or *may* depending on the context. There is, however, a preference for a universal interpretation. Another point comes from constructions in which a universal interpretation would lead to a contradiction. An example of such a construction is given in (328). The embedded propositions are contradictory.

- (328) k'a ih-zúqw-as tu7 ni7 na núkw-a qelhmín smúlhats k'a  
 INFER COMP-die-3CONJ then DEMON DET other-DET old.person woman INFER  
 lh-mím'c-as tu7 nka7  
 comp-move-3CONJ then where  
 'Maybe the other old woman died or maybe she moved somewhere.' Rullmann  
 et al. (2008) (13), p. 324

The translation of (328) is given with disjunction, but Rullmann et al. (2008) claim that (328) would be contradictory with a universal interpretation and provides a comparison with *must* and conjunction, as in (329).<sup>6</sup>

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<sup>6</sup>The English counterpart with disjunction in (i) does not seem to be contradictory.

(329) #The other older woman must have died, but she must have moved somewhere.

Given these facts, Rullmann et al. (2008) analyze these modals as universal with a choice function that can restrict the worlds in the modal base. Depending on the amount of restriction, the modal can be weakened to the point of having an interpretation closer to an existential. A schema for the denotation of a modal is given in (330).

(330)  $\llbracket \text{MODAL} \rrbracket^{c,w}$  is only defined if  $c$  provides a modal base  $B$ .  
 $\llbracket \text{MODAL} \rrbracket^{c,w} = \lambda f_{\langle st, st \rangle} . \lambda p_{\langle s, t \rangle} . \forall w' [w' \in f(B(w)) \rightarrow p(w')]$  (53), p. 338

The schema in (330) was proposed for the variable force modals of St'át'incets. It has also been proposed that variable force modals in other languages are instead existential but can be strengthened in a context (Deal (2011) for Nez Perce, Peterson (2008) for the Tsimshianic language Gitksan). I won't discuss these modals any further because the inferentials are claimed to be of the first type.

Mihoc (2012), Rivero (2014), Rivero and Simeonova (2014) adopt Kratzer's (2012) analysis of the universal type variable force modals—what she calls “variable-force upper-end degree modals”. Kratzer (2012) claims that the work of the choice function proposed by Rullmann et al. (2008) can be done by the independently motivated ordering source. The ordering source restricts the world of the modal base, and depending on the restriction the modal can receive different interpretations.

This analysis builds on the graded theory of modality in which modals are interpreted relative to a modal base and an ordering source. The modal base is a set of worlds, and the ordering source is a partial order on those worlds. This ordering might be the most stereotypical or desirable worlds. Under this view, a necessity modal does not require that the prejacent

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(i) The other older woman must have died, or she must have moved somewhere.

The sentence in (i) receives an interpretation that is very different from the gloss for (328). This is one in which one of the embedded propositions must be the case; we just need to figure out which. Maybe the speaker is comparing two sets of evidence.

is true in all worlds in the modal base, but instead only that it is true in the most stereotypical or most desirable worlds in the modal base. A possibility modal does not require that the prejacent be true in at least one world of the modal base, but instead that its negation isn't necessary, in the sense of necessary just described.

Rather than thinking of a variable force modal of the St'át'imcets type as a universal modal, Kratzer (2012) proposes that it is similar to a degree expression. These modals require that the prejacent be (somewhat) probable or (somewhat) desirable rather than strictly necessary. Rather than covering probabilities that correspond to necessary, it covers all high degrees of probabilities on the scale. Exactly which degrees count as the upper-end is left unspecified. This allows the modal to receive an existential interpretation in some contexts.

#### 6.4.2 Evidence that co-opted future markers are variable force modals

The evidence provided for inferentials being variable force modals is different for the different languages. For Spanish and Bulgarian, the evidence comes from sentences that would be considered contradictory if the inferential were a universal. The sentences for each are schematized below.

(331) where  $p$  and  $q$  are incompatible...

- |    |  |                 |
|----|--|-----------------|
| a. | $\checkmark_{\text{INFER-}p}$ , and $q$          | Fut (Spanish)   |
| b. | $\checkmark_{\diamond p}$ , and $\text{INFER-}q$ | Fut (Bulgarian) |

Ideally, the same construction would be tested in all the languages. Unfortunately, this data isn't provided by the authors. I will, however, compare how English *will* behaves in these constructions. Each will be discussed below.

In Spanish, Rivero (2014) argues that the inferential cannot be analyzed as a universal because of its behavior in what she calls a "mirative" use. An example of this is in (332). She labels this a mirative use because the inferential is not anchored to the speaker. Intuitively, B's

response might be paraphrased as *Given what you say, he must speak clearly. But I don't think he does*. Rivero (2014) glosses this use of the inferential as *may* or *might*.

- (332) A: Juan habla muy claro.  
John speaks very clear  
'John speaks very clearly'
- B: Hablará claro, pero yo no le entiendo nada.  
speak.Fut clear, but I Neg him understand nothing  
'He may/might speak clearly, but I do not understand anything he says.'

Notice that the English version of B's response with both *must* and *will* is unacceptable. There seems to be a real difference between *will* and the Spanish inferential.

- (333) a. #He must speak clearly, but I do not understand anything he says.  
b. #He will speak clearly, but I do not understand anything he says.

The sentences in (333) become acceptable only when the modal base is overtly marked to be shifted away from the speaker, as when *given what you say* is added to the first clause. When the modal is shifted in this way, these sentences no longer constitute an argument for the modal not having universal force. This is because the two clauses are no longer incompatible, notice that even *must* is acceptable in this context.

Another way of characterizing the difference between the Spanish inferential and English *will/must* is that the Spanish inferential can more easily shift the perspective or the judge of the modal/inferential. In addition to this difference in perspective shifting, there may also be a difference in force. This difference in force, however, would be obscured in the mirative cases.

Let's now turn to Bulgarian's future-tense marker *šte*. Rivero and Simeonova's (2014) motivation for the claim that it is not a universal modal comes from cases of conjoined possibility modals with the inferential, as in (334). In this example, *šte* is translated as *more likely*. The prejacent in each of the conjuncts are claimed to be possible, ruling out a necessity reading.

- (334) Može da e bil Ivan, ili/no šte da e bil Boris.  
 may da be<sub>PRES.3SG</sub> bepp Ivan or/but FUT da be<sub>PRES.3SG</sub> bepp Boris  
 ‘It could have been Ivan, but it is more likely that it was Boris’

Rivero and Simeonova (2014) (32)

English *will* can’t occur in the equivalent of (334), as shown in (335).

- (335) a. #It could have been Ivan, but it will have been Boris.  
 b. #It might have been Ivan, but it will have been Boris.

The past time reference could introduce a confound in this construction. Each of the possibilities might be interpreted as holding at a different time. For example, the sentences in (335) might be interpreted as *given our initial information, it could have been Ivan, but in light of the new evidence, it will have been Boris*. To control for this, a present tense variant should be used, as in (336).

- (336) Where is John?  
 a. #He might be at home, but he will be work.

As expected, the present tense version of (335) is also unacceptable. This possibility is not discussed for Bulgarian by Rivero and Simeonova (2014), so it is unclear if the change in tense would affect the acceptability of (334).

There are also differences between the variable force modal discussed by Rullmann et al. (2008) and the inferential in Bulgarian. The counterpart of (328) in Bulgarian, (337), is unacceptable.

- (337) #Šte da e bil Ivan, ili/no šte da e bil Boris.  
 FUT da be<sub>PRES.3SG</sub> bepp Ivan or/but FUT da be<sub>PRES.3SG</sub> bepp Boris  
 ‘It must have been Ivan, or it must have been Boris’

Rivero and Simeonova (2014) (34)

It is an open question why these modals differ in this way. Rivero and Simeonova (2014) adopt Kratzer's (2012) analysis of variable force modals directly, so there is nothing in the theory to predict this difference.

English *will* and *must* both are acceptable if the two sentences are disjoined with *or*, but they are not if conjoined with *and* or *but*.

- (338) a. It must have been Ivan, ✓or/#but it must have been Boris.  
b. It will have been Ivan, ✓or/#but it will have been Boris.

Again, just as with the previous data, it is important that the modal base is kept constant (no shift in judge or time) in order to examine the force properties of the modals. For this reason, these data should be considered within a more articulated context.

Finally, the evidence that the Romanian inferential is variable force, rather than universal, comes from translation. Mihoc (2012) writes: "The biggest challenge to an epistemic modal analysis of [the inferential] is posed by its epistemic force. The reason is that it does not appear to map straightforwardly to either a possibility of necessity modal" (p. 74). The variability in translation is primarily found in questions. In assertions, the inferential is translated as *will*, *must*, or *probably*.

The arguments for the inferentials being variable force come in two types. The first type comes from creating sentences that would be contradictions if the inferential were interpreted as a universal. As discussed above, a potential confound of these are that the judge of the temporal argument of the modal might be shifted. The second type of argument comes from the translation of the inferential into English. This type of argument cannot be empirically evaluated or compared with English *will* because it is instead a matter of native speakers' intuition.

### 6.4.3 Are all inferential readings of future markers variable force modals?

Given that a variable force analysis has been proposed for inferentials in a variety of languages, we might wonder whether all future-tense markers and/or their present-inference uses are variable force. Specifically, we might wonder whether English PT *will* is variable force.

The data that have been used to argue for a variable force analysis of various modals/inferentials are (i) translation facts and (ii) the constructions in (339).

- (339) where  $p$  and  $q$  are incompatible...
- |    |   |                           |
|----|---|---------------------------|
| a. | $\checkmark_{\text{INFER-}p}$ , or/but $\text{INFER-}q$ | <i>k'a</i> (St'át'imcets) |
| b. | $\checkmark_{\text{INFER-}p}$ , and $q$                 | Fut (Spanish)             |
| c. | $\checkmark_{\diamond p}$ , and $\text{INFER-}q$        | Fut (Bulgarian)           |

These constructions involve conjoining two sentences which embed conflicting propositions. For each, if the inferential were analyzed as a universal modal, these sentences should be a contradiction (assuming the modal base remains constant).

Before discussing the English data, it is important to first point out that the behavior of modals that have been analyzed as upper-end degree modals is not uniform. For example, as discussed above, the Bulgarian future marker *šte* does not behave like St'át'imcets' *k'a* in being acceptable in the construction in (339a). A similar point is that the same tests were not used across languages, so we cannot be confident that the inferentials behave uniformly, despite the fact that the authors propose the same analysis for all the inferentials. For this reason, it would be useful to have a more direct and in-depth comparison of the inferential markers even within the languages already discussed (Romanian, Spanish, Bulgarian) to see if these languages all behave uniformly.

Turning to English, Stalnaker (1981) has claimed that *would* (as found in counterfactuals) does not have a dual and that the universal and existential interpretations of this modal are collapsed. If we assume that *will* and *would* derive from a single modal *woll*, the claim that *would* is variable force could be used to argue that *will* is also variable force. In this section,

I will focus on *will* data to avoid the complexity of counterfactuals. Before turning to the tests in (339), I will briefly discuss my native speaker intuition, which I take to be somewhat analogous to the translation task discussed by these authors.

There is an intuition that PT *will* is very strong (without any adverbial modifiers). For example, in (340) the speaker thinks it is “probable” or “most likely” that Brianna is at yoga, yet the use of *will* is too strong.

- (340) *On Saturday mornings, Brianna is always either at spin class or yoga. Spin is expensive though, so it is much more likely she is at yoga. Someone asks where Brianna is:*
- a. #She will be at yoga.
  - b. She is probably at yoga.
  - c. She is most likely at yoga.

In general, *will* seems to carry a requirement of speaker commitment to the truth of the preja-cent. *Will* is unacceptable in any context where there is doubt or multiple possibilities considered.

It also doesn't seem that *will* is acceptable in any of the constructions in (339). These sentences are repeated below in (341).

- (341) a. #It will have been Ivan, or/but it will have been Boris.  
b. #He will speak clearly, but I don't understand anything he says.  
c. #It might have been Ivan, but it will have been Boris.

While English *will* doesn't pass these tests, there is other evidence that *will* might be variable force, rather than universal. Kissine (2008) claims that *will* does not itself encode universal force, but instead the universal force comes from a default speech act operator, such as ASSERT. He argues for this position, partially, with the compatibility of *will* with possibility modals, as in (342).



- (342) a. John will {possibly/probably} be home.  
b. #John must {possibly/probably} be home.

In the context in (340), *will* is acceptable once a possibility adverb is added, such as *Brianna will probably be at yoga*.

If *will* is analyzed as an upper-end degree modal, rather than an epistemic, its interpretation would be closer to (somewhat) probable, rather than necessary. This fits well with *will*'s behavior as a Neg-Raising Predicate (NRP). Horn (1978) observes that NRPs are positive midscalar operators. For example, *should* is a NRP (Homer 2015), but not *have to*.

I leave the question of the force of PT *will* and other inferentials (co-opted future markers) for future work. The work of Mihoc (2012), Rivero (2014), Rivero and Simeonova (2014) taken together has certainly discovered an interesting cross-linguistic fact about these co-opted future markers. There are many aspects that still need to be explored: How do these inferentials differ from one another? Do they differ in their ability to shift the world or judge of evaluation (e.g., the Spanish mirative)? Do they differ in how readily they can receive an existential interpretation (or lower end of the upper-end degrees)? And finally, how do these modals differ from the variable force modals found in other languages?

## 6.5 Connection to the future

Chapter 5 pointed out that not only does present-tense *will* necessarily scope above clause-mate negation, so does future-tense *will*, as shown in the sentences in (343).

- (343) a. Gina won't make dinner tonight.  
b. Londen won't be home tomorrow.  
c. Noah won't attend school tomorrow.

If *will* were interpreted in the scope of negation in these sentences, the interpretation would be quite surprising. Recall that future *will* is generally analyzed as a universal modal quantify-

ing over an epistemic/metaphysical/totally-realistic modal base (Condoravdi (2002), Werner (2006), see Chapter 2). If negation scoped over the universal modal, we would expect a reading that denies the universal claim. For example, (343a) would mean something like it isn't necessarily the case that Gina cooks dinner tonight, she might or might not. This is most certainly not an available reading of (343a). In fact, it would be a surprising interpretation for a negated future sentence in any language.

If a language's future marker is modal, as English *will* is, we expect it to have some mechanism to outscope negation. In fact, I think it would be surprising if we found a language in which the equivalent of (343a) had the meaning described above. The Excluded Middle presupposition might just be one way languages can derive the future-marker over negation scope. I leave for future work whether there exists language variation on this point and, if there is, how it is derived.

## CHAPTER 7

### Conclusion

There are two main empirical generalizations put forth in this dissertation:

(344) EMPIRICAL GENERALIZATIONS

- a. **Inferential restriction:** present-tense *will* is only licensed when the prejacent has been concluded using a non-abductive inference.
- b. **Interaction with negation:** present-tense *will* is never interpreted in the scope of negation.

The inferential restriction is the focus of Part I of the dissertation. In an assertion, the use of present-tense (PT) *will* is infelicitous if the speaker concludes the prejacent from an abductive reasoning. This is seen clearly in cases of inferring from a result state to its cause. This restriction is one way that PT *will* differs from epistemic *must*; *must* does not obey this restriction. In addition to showing that this property holds for PT *will*, I have also shown that it holds for other future-tense markers cross-linguistically that have been co-opted to mark a present inference.

Chapter 4 argued that the restriction against abductive inferences cannot be derived from the temporal properties of causation (that causes temporally precede their result states). It also showed that the restriction on *will* is inherently relational, restricting how the evidence relates to the prejacent, rather than the evidence itself. Given this, the restriction is better modeled in Krawczyk's (2012) theory of evidence relations, rather than a restriction on the evidence as is done for some epistemic modals (Matthewson et al. 2007, von Stechow and Gillies 2010, Matthewson 2015). Any analysis of the inferential restriction of *will*, however, needs to

rely on an understanding of how different inferences are modeled in the semantics. For this reason, a complete analysis of *will* and how it differs from *must* is left for future work.

The second empirical observation is about how PT *will* interacts with negation, discussed in Part II of the dissertation. Given the assumption that *will* encodes universal quantification, we never see PT *will* interpreted in the scope of negation. This is another way that PT *will* differs from epistemic *must*. While both modals outscope clause-mate negation, there are environments where epistemic *must* is interpreted in the scope of negation, but *will* never is. In addition to showing that this property holds for PT *will*, I have also argued that in general if future tense markers are universal modals, they likely have some mechanism for outscoping negation.

Chapter 6 showed that PT *will* behaves like Neg-Raising Predicates (NRPs) in that it participates in cyclic Neg-Raising and licenses Strict Negative Polarity Items (NPIs) in its scope. It also showed, however, that *will* differs from traditional NRPs, as *think* and *want*, in that it obligatorily receives a Neg-Raising interpretation and projects out of truth-conditional operators. For this reason, I proposed that Gajewski's (2005) presuppositional analysis of NRPs is appropriate for a new class of NRPs, including *will*, which can be described as "Strict" NRPs. This analysis raises a larger question of what the typology is of polarity sensitive modals. Homer (2015) claims that deontic *must* is a (mobile) PPI, and deontic *should* is both a (mobile) PPI and a traditional NRP. I have claimed that epistemic *must* is neither a PPI, nor an NRP, yet it does scope out of negation in certain contexts.

Following others, I analyze PT *will* as an epistemic modal (Condoravdi 2002, 2003, Werner 2003, 2006, Kaufman 2005, Giannakidou and Mari 2014). There is an open question as to what makes a lexical item an epistemic modal and how much variation occurs within this category. The empirical generalizations in (344) constitute (at least) two ways in which epistemic modals can vary: they can vary in the type of inference the speaker has for the prejacent, and they can vary in how they scope relative to negation. Ideally, the semantics of epistemic modals would predict these points of variation.

## 7.1 Future directions

This section discusses more speculative points and suggests paths for future research. Section 7.1.1 provides additional evidence that these generalizations hold for all uses of *will*, as well as *would*, although see Section 2.5 for a discussion of conditional sentences. Section 7.1.2 discusses some loose connections between the two parts of the dissertation and discusses the possibility that they could be derived from a single source.

### 7.1.1 Other uses of *will*

The dissertation focused on present-tense uses of *will* in which the speaker has inferred the truth of the prejacent. (345) is a list of other uses or “flavors” of *will*, adapted from Kissine (2008), citing Palmer (1979). I use the term *flavor* because it isn’t clear that these are all distinct interpretations of *will*.

(345) FLAVORS OF *will*

- a. Future/Predictive
  - (i) Mary will come tomorrow.
- b. Generic
  - (i) Oil will float on water.
- c. Epistemic
  - (i) Mary will be at the opera now.
- d. Habitual/Dispositional/Volitional
  - (i) In Winter, Mary will (always) wear a green coat.
- e. Deontic
  - (i) You will leave tomorrow by the first train (and you’ll like it).
- f. Hypothetical/Counterfactual
  - (i) John would have won the race (if he hadn’t tripped).

This section will discuss some of the different flavors of *will* and argue that they obey the two empirical generalizations found for epistemic *will*—those in (344).

#### 7.1.1.1 Generic/habitual/dispositional/volitional

The the generic, habitual, dispositional, and volitional interpretations of *will* all require an inference. As Kissine (2008) points out, the generic reading is incompatible with the speaker having direct evidence. One cannot see oil floating on water and say *Oil will float on water*. This is harder to test with the habitual/dispositional/volitional readings because it isn't clear what counts as direct evidence for a habit, disposition, or desire.

These flavors also share another property: they are different types of non-abductive inferences. For the generic interpretation, the speaker concludes the prejacent from a law. For the habitual interpretation, the speaker concludes the prejacent from a habit. For the dispositional interpretation, the speaker concludes the prejacent from predictable behavior. And for the volitional interpretation, the speaker concludes the prejacent based on desires or plans. Thus, we can think of these readings as a subset of the epistemic cases.

These flavors also show the same interaction with negation. As shown in (346), *will* also necessarily scopes above negation when it is interpreted with these various flavors.

- (346)
- a. Oil won't float on water.
  - b. In the winter, Mary won't wear a green coat.
  - c. In the winter, Mary won't always wear a green coat.

(346a) does not have a reading in which *will* scopes under negation, giving rise to a meaning paraphrasable as oil doesn't necessarily float on water; it may or may not. Likewise, (346b) doesn't have an interpretation paraphrasable as it's not necessary that Mary wears a green coat in the winter.

### 7.1.1.2 Predictive

There has been wide disagreement about the interpretation of the predictive use of *will*. There have been a number of suggestions for which modal base it relies on: epistemic or metaphysical (Condoravdi 2002, 2003), totally realistic/not epistemic (Werner 2003, 2006), objective epistemic (Kaufman 2005), circumstantial (Abusch 2012), and epistemic (Giannakidou and Mari 2014). I will not contribute to this debate here, but rather will show that whatever modal base predictive uses of *will* rely on, they empirically follow the generalizations in (344).

As discussed in Chapter 2 future/predictive uses of *will* automatically satisfy the inferential restriction. First, any claim about a future eventuality cannot rely on direct evidence, but instead must involve an inference. This is because future eventualities cannot be perceived from the present. Second, inferences about the future are necessarily not abductive. If an eventuality holds in the future, then its result states aren't observable from the present.

As discussed in Chapter 6, future uses of *will* also necessarily scope out of negation. This is shown in (347).

- (347) a. Gina won't make dinner tonight.  
(i) WILL > NEG  
b. Cassy doesn't think Terra will make dinner tonight.  
(i) THINK > WILL > NEG

(347a) does not have an interpretation which is paraphrasable as Gina isn't necessarily going to cook dinner tonight; she might not (NEG > WILL). (347a) very clearly means that she is going to not cook dinner tonight. (347b) shows that future *will* also shows full cyclicity when embedded under negated Neg-Raising Predicates.

### 7.1.1.3 Counterfactual/hypothetical

Following Abusch (1988, 1997, 1998), I assume that *would* is the past tense counterpart of *will*. The counterfactual/hypothetical uses of *would* also seems to obey the empirical gener-

alizations for *will* in (344), although these results are less clear for the inferential restriction. In fact, Schulz (2007) claims that some counterfactuals do not allow reasoning from a result state (antecedent) to their cause (conclusion), see Section 2.5.

Consider (348). This is an abductive context because the speaker reasons from a result state (smoke) to its cause (Terra cooking the turkey). This inference can be felicitously reported with *would* in the Anaphoric Construction (AC), but cannot be with its Non-Anaphoric Counterpart (NAC).

- (348) *Abductive context: It's Thanksgiving and all the guests are over. The house starts to fill with smoke.*
- a. #Terra would be cooking the turkey.
  - b. That would/will be Terra cooking the turkey.

In the abductive context a result state is present. If the result state is present (in the actual world), then the eventually actually occurred. This blocks the counterfactual or hypothetical meaning. (348b) does not carry any hypothetical or counterfactual meaning.

The pattern in (348) can be compared with that in a non-abductive context, as in (349). This is a non-abductive context because the speaker is inferring the whereabouts of the family based on their plans, not from a result state. In this context the NA sentences are improved.

- (349) *Non-abductive context: It's Thanksgiving. The guests start to arrive, and ask about the whereabouts of the family.*
- a. Terra would be cooking the turkey.
  - b. Cassy would be in Vegas.

The sentences in (349) could also contain *will* instead of *would*. The forms with *would* might be being used to convey politeness. This doesn't, however, seem to be the case for (348b).

The surprising fact about the acceptable uses of *would* in (348) is that the hypothetical or counterfactual meaning is missing. *Will* and *would* seem to be neutralized in these contexts.



If we turn to a truly hypothetical/counterfactual context, *will* and *would* pull apart. This is shown in (350).

- (350) *Hypothetical/Counterfactual context: Londen complains, it's Thanksgiving, and we don't have a turkey. Jerry says, don't complain...*
- a. Terra would be cooking a turkey right now...
    - (i) ...if you had asked her.
    - (ii) ...if the oven still worked.
  - b. #Terra will be cooking a turkey right now...
    - (i) #...if you had asked her.
    - (ii) #...if the oven still worked.

These sentences show that *would* cannot be used in an abductive context, unless the Anaphoric Construction is used. This completely parallels the pattern observed with *will*.

Hypothetical/counterfactual uses of *would* also show the same interactions with negation as epistemic *will*. This is shown in (351).

- (351) a. If Cassy were around, Terra wouldn't cook a turkey.
  - (i) ✓ WILL > NEG
- b. If Lindsay had forgotten the password, she wouldn't have entered the building.
  - (i) WILL > NEG

(351b) does not mean that if Lindsay had forgotten the password, it wasn't necessary that she entered the building, that is, if she had forgotten it, she may or may not have entered the building. Instead, what it does mean is that if she forgot the password, it is necessary that she didn't enter the building.

#### 7.1.1.4 Summary

The empirical generalizations for PT *will* in (344) seem to extend to other flavors of *will/would*. They all show the same interaction with negation. *Will* is simply never interpreted in the scope of negation.<sup>1</sup> Additionally, none of the other flavors of *will*, besides the epistemic one, even provides a chance for the inferential restriction to be violated. The generic, habitual, volitional, and dispositional uses of *will* are by definition non-abductive (e.g., an inference based on a habit is not abductive). The predictive uses are non-abductive because an inference to a future eventuality cannot be based on its result state (causes precede results). Finally, if an eventuality is non-realized, as it is with a counterfactual/hypothetical use of *will*, then its result state is also necessarily non-realized. In the specific contexts that *would* can be used with a realized result state, it can only be used with the Anaphoric Construction and is unacceptable with its Non-Anaphoric counterpart.

#### 7.1.2 How the two parts might be connected

The two portions of this dissertation have been presented as independent empirical observations about *will*. One might wonder, however, if these two properties are actually independent. In this section, I will present an intuitive connection between the two, and I will show how this connection could be leveraged to give a unified analysis to these two properties of *will*, as well as to other future-tense markers. I will also discuss some challenges for this approach.

The excluded middle presupposition proposed in Chapter 6 for *will* requires that all the worlds in the modal base be settled: either all worlds make the prejacent true or none of them do. There is an intuitive reason why a modal that has a settledness requirement on its modal base would be incompatible with abductive inferences.

One notable fact about abductive reasoning is that it is not logically valid. This can be seen in what happens when the speaker gains more information. Douven (2011) writes, “A noteworthy feature of abduction, which it shares with induction but not with deduction, is

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<sup>1</sup>It is possible that this should be taken as evidence that *will* is not quantificational. I don’t consider this possibility here, but I don’t provide direct arguments against it.

that it violates monotonicity, meaning that it may be possible to infer abductively certain conclusions from a subset of a set  $S$  of premises which cannot be inferred abductively from  $S$  as a whole.”

Assuming that a premise set is true, if  $p$  is concluded abductively from that premise set, the validity of  $p$  is not guaranteed. If more information is added to the premise set,  $p$  might turn out to be false. This is shown in the examples (352)-(353) below. (352) is an abductive argument for the conclusion that it has rained. In (353) the premise set of (352) is expanded to include the information that a group had a water gun fight. The premise set from (352) is maintained; it just expands it to include more information. This expanded premise set no longer supports the conclusion from (352).

(352)            It rained  $\rightarrow$  The ground is wet  
                  The ground is wet  
                  -----  
                  It rained

(353)            It rained  $\rightarrow$  The ground is wet  
                  The ground is wet  
                  A group of teenagers had a Super Soaker (water gun) fight outside  
                  -----  
                  It didn't rain

As discussed in Chapter 2, abductive inferences to best-fit conclusions could be modeled as conditional probabilities (Krawczyk 2012 following Lipton (2003)). In the example in (352), the best-fit explanation for the ground being wet is that it has rained. Given the premise set, it is very likely that it rained, but it is not guaranteed. The use of abductive reasoning is ubiquitous, and speakers might be certain that their conclusion is true, but it is not logically guaranteed to be true. Speaker certainty is not equivalent to logical validity. A speaker may think in (352) that the only reason for the ground to be wet is that it rained. Therefore, if she sees that the ground is wet, she is certain that it rained. No matter how certain the speaker is, the inference is still an abductive inference, and thus not logically valid.

If this is the case, then the worlds compatible with the propositions in the premise set in (352) are not all worlds in which it rained. Not all the worlds in the modal base are worlds in which the conclusion holds. The modal base is thus unsettled, and the presupposition of *will* is unsatisfied. While this seems like it could be a reasonable explanation, more work is still needed. It isn't clear that every inference that *will* marks is strictly speaking logically valid. Specifically, there are other inferences that *will* is compatible with which are not logically valid. Specifically, consider the example in (354).

You strike a match  $\rightarrow$  it lights

(354)      I struck a match

$\therefore$  The match lit

If this premise set is expanded, as in (355), the conclusion no longer follows from the premise set.

You strike a match  $\rightarrow$  it lights

(355)      I struck a match

The match lit

---

The match didn't light

The examples in (354)-(355) are parallel to those in (352)-(353), yet the felicity of *will* differs in the two contexts. The inference in (352) cannot be reported with *will*, but the inference with (354) can, as in (356).

(356)      A: He just struck a match.

B: It will have lit.

Given (356), it seems that the abductive requirement cannot be derived solely from the fact that abductive inferences are not logically valid.

Additionally, a crucial part of any analysis of *will* is to predict the contrast with epistemic *must*. If an abductive inference is not logically valid, and does not lead to a settled modal base,

why is *must* compatible with it? While *must* does not carry an Excluded Middle inference, it does universally quantify over the modal base, asserting that all worlds satisfy the prejacent. If the modal base isn't settled with respect to *p*, we might expect *must-p* to be false. Throughout the dissertation, I have been ignoring the role of *must*'s ordering source. *Must* is claimed to have a stereotypical or doxastic ordering source, while *will* does not. The fact that *must* has an ordering source might explain why it is compatible with an abductive inference. For (352), not all worlds compatible with the premise set need to be worlds in which it rained; only the best or most typical worlds need to be.

This type of analysis derives the incompatibility of *will* with abductive reasoning from its interaction with negation. Recall that Chapter 2 discussed that, cross-linguistically, future markers that are co-opted for present inference are generally incompatible with abductive inferences. This pattern was explained by appealing to the fact that inferences about the future are necessarily non-abductive. The analysis discussed here, however, abandons this explanation. Instead, it accounts for the cross-linguistic pattern, it would need to explain why future markers cross-linguistically (or at least modal ones) interact with negation in a particular way.

The connections between *will*'s incompatibility with abductive reasoning and its interaction with negation are very speculative at this point, and I leave for future work how the intuitions in this section can be made concrete. Given a better understanding of how natural language treats these different inference types, it is also possible that the non-abductive requirement follows from another aspect of the semantics of these future tense markers.

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