Possibilities in discourse: The pragmatic presuppositions of epistemic *may*/*might* and *must*

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I dedicate this dissertation to

my mother, Jean Tabolt, and my father, Tim Tabolt,

for bringing me into the world and sending me off to explore it.

Abstract

The object of this dissertation is to identify the commitments communicated by assertions using epistemic *may/might* and *must*, and to explain how those commitments are different from one another, how they are alike, and how they are affected by and help shape the surrounding discourse. The proposal within consists of an account of how the semantics of epistemic modal propositions (Kratzer, 1977, 1981, 1991, 2012) interact with the assumptions contained in the common ground (Stalnaker, 1973, 1978, 1996, 2002) at the time of utterance, as mediated by the Cooperative Principle (Grice, 1989).

I show that the propositional content of modal assertions is systematically constrained, in terms of the modal base, by quantity demands. Factoring in the quantity demand results in modal assertions adding more to the common ground than would be predicted based on their truth conditional content alone. This has implications for many key areas in the literature on epistemic modals, including empirically adequate truth conditions, differentiating between subjectivity and objectivity, agreement and dissent facts, embeddability facts, and proffering speech act effects.

According to possible worlds semantics of epistemic modals, epistemic modals denote that their embedded proposition (called **the prejacent**) is possible or necessary relative to Speaker's knowledge. According to the Stalnakerian model of assertion, an assertion is a proposal to add the truth conditional content of the asserted proposition to the common ground. As such, accepting an assertion of a modal proposition should result in "the prejacent is possible/necessary according to Speaker's knowledge" being added to the common ground. This should not result in any change in commitment toward the prejacent by other discourse participants. However, this is not what actually happens.

    (1)*There's a knock at the door,*   "That may/must be Bob." --   "I see. ?I doubt it."

Hearer indicates that she accepts Speaker's assertion by uttering "I see." Then, given that she has not gained new knowledge between uttering the two sentences, she contradicts herself by asserting that the prejacent is doubtful (*May* can sometimes express doubt, especially when pronounced with marked intonation. We are not concerned with

that reading at the present time.) That is, empirically, what is taken to be added to the common ground by accepting a modal assertion is more than just "the prejacent is necessary/possible <u>according to Speaker's knowledge</u>". It is taken to change the prejacent's status relative to the acceptor's knowledge, contrary to the theoretical expectations.

In general, an assertion can be taken as a public commitment by Speaker to the content of the asserted proposition which, by virtue of having being publicized, will prompt Hearer to also commit to it. Since we perceive that Hearer's accepting Speaker's assertion changes Hearer's own beliefs regarding the prejacent, we must be interpreting Speaker's assertion as a commitment to more than just the prejacent's status relative to his own internal knowledge. <u>What is Speaker committing himself to by uttering a modal assertion</u>?

An investigation of this question can start by identifying the similarities and differences of modal assertions with non-modal assertions and questions. According to standard possible worlds semantics, necessity operators like *must*, when interpreted in their epistemic sense, express that the prejacent is the only possibility given what Speaker knows. This would entail that Speaker knows that the prejacent is true. In following, *must* can be compared with non-modal assertions, which denote that the asserted proposition is true.

Possibility operators like *may/might*, in their epistemic sense, express that the prejacent may be either true of false according to what Speaker knows. In following, *may/might* can be notionally compared with polar questions, which also express that Speaker does not know if the proposition under question is true or false. However, neither of the above two comparisons adequately captures what Speaker commits himself to by virtue of *may/might* or *must* assertions.

(2) Question:	Did John leave already?	No, he didn't.
(3) Possibility assertion:	John may have left already.	! No, he didn't.
(4) Necessity assertion:	John must have left already.	!! No, he didn't.
(5) Non-modal assertion:	John left already.	!!! No, he didn't.

In (2)-(5), a rejection of the uttered proposition by Hearer is increasingly confrontational, indicated by the

number of exclamation marks. There seems to be a gradient of strength of commitment toward "John left already", where questions express no commitment to either truth or falsity and non-modal assertions express commitment to truth. The perceived strength gradient among (2)-(5) suggests that, unlike questions, *may/might* and *must* express some positive commitment by Speaker to "John left already", but that unlike non-modal assertions, one which is not to its truth. <u>What can Speaker be committed to if not to the truth of the proposition</u>?

Kratzer proposed a "human" modality semantics, in part to account for the difference between (4) and (5). Within this framework, epistemic *may/might* denote "stereotypical" possibility. A stereotypically possible proposition is more than just epistemically possible, it is an epistemically possible "normal state of affairs." Meanwhile, *must* denotes "stereotypical necessity," which means that the prejacent is the <u>only</u> epistemically possible "normal state of affairs." Under Kratzer's proposal, we might suppose that the commitment expressed by epistemic modality assertions is toward the stereotypical possibility/necessity of the prejacent. This works well for necessity but runs into problems with possibility.

Suppose that "John left" is a normal state of affairs if John has other plans, but "John did not leave" is a normal state of affairs if there is a girl he likes at the party. In order to truthfully utter (4), Speaker must know that John has other plans and cannot know that there is a girl John likes at the party (in reality, there may or may not be one). In general terms, Hearer can deduce that Speaker has positive evidence for the prejacent, and that he believes that there is not any positive evidence for the complement of the prejacent. This does not entail a commitment to the prejacent being <u>true</u> but is nonetheless a positive commitment toward it. However, the question remains <u>why Hearer's accepting that there is positive evidence for the prejacent and not for the prejacent's complement according to Speaker's knowledge should translate to a commitment by Hearer to the prejacent.</u>

There is an additional hurdle for (3). Our semantics does not require even any positive evidence. The only way for (3) to be false, given that Speaker does not know that the prejacent is false, would be if "John did not leave" were humanly necessary. This means that Speaker can truthfully utter (3) as long as he doesn't know whether there's a girl at the party that John is interested in. In general terms, the only thing Hearer can deduce semantically from a true human possibility proposition is that Speaker does not know anything that contradicts the prejacent being a normal

state of affairs (e.g. there being a girl John is interested in at the party).

Since semantically all that is required to utter *may* is a lack of knowledge, there appears to be no reason why Speaker would have to be interpreted as having a positive commitment toward the prejacent by uttering a *may* assertion, and so human modality does not offer an explanation for why possibility assertions should express a stronger commitment than polar questions. For possibility, even before pursuing the question of how to translate Speaker's commitment to Hearer's commitment, we have the problem of finding a commitment by Speaker at all.

Both the question of what commitments of Speaker are expressed by modal assertions, and of how commitments to a prejacent based on the contents of Speaker's knowledge can translate to commitments to the prejacent by Hearer in the common ground can be answered by factoring in the quantity demand. I propose that, based on Hearer's expectation as per the Cooperative Principle that Speaker is trying to update the common ground, Hearer can derive non-modal pragmatic presuppositions, i.e. non-modal propositional beliefs to which she takes Speaker to be committed, based on the denotation of the modal forms he uses.

The process of derivation of pragmatic presuppositions is dependent on the state of the common ground. In order to make an assertion in accordance with the quantity maxim, Speaker must believe he is contributing to the common ground. If the common ground entails only that a proposition may or may not be true, a human modality assertion can add that there is positive evidence for it. Since Hearer expects Speaker to obey the quantity maxim, she expects that Speaker, since he has made a modal assertion, believes he has positive evidence.

For human necessity, this expectation results in his modal commitments regarding his knowledge being taken to be non-modal commitments regarding the actual world by virtue of the Cooperative Principle. Meanwhile, possibility propositions only require a lack of knowledge to be true, but since possibility assertions have to update the common ground, Hearer assumes that Speaker would not assert a human possibility if he did not have positive evidence for the prejacent. If Hearer takes an assertion as indicative of Speaker having such positive evidence and accepts it, she will be committed to the belief that it exists in the common ground. Thus, human modality semantics as constrained by the quantity maxim allows an explanation of the positive commitment Speaker expresses by modal assertions and of how Speaker's commitments can translate to common ground commitments.

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A necessity assertion commits Speaker to believing there is positive evidence for the prejacent but not for the prejacent's complement. That is, it produces two non-modal pragmatic presuppositions which are taken as commitments by Speaker. A possibility assertion only commits Speaker to believing there is positive evidence for the prejacent, but leaves him uncommitted to the prejacent's complement. That is, it too produces a non-modal pragmatic presupposition which is taken to be a commitment by Speaker, but it also produces a non-committal pragmatic presupposition.

The two pragmatic presuppositions produced by modal assertions, one regarding the prejacent and one regarding the prejacent's complement, raise what I call "modal issues" in discourse. A modal issue can be taken as a proposal to narrow down the possible "possibility configurations" for a given proposition with respect to the common ground. By human modality semantics, a proposition and its complement can both be stereotypically possible (e.g. John's having left already may be stereotypically possible because he has other plans at the same time as it is astereotypically possible because there's a girl he's interested in at the party). This allows for five different possibility configurations in which a proposition and its complement can be: [1] $p_{impossible}$ & $\neg p_{epi.necessary}$, [2] $p_{epi.necessary}$ & $\neg p_{impossible}$, [3] $p_{astereo.possible}$ & $\neg p_{stereo.necessary}$, [4] $p_{stereo.necessary}$ & $\neg p_{astereo.possible}$, [5] $p_{stereo.possible}$ & $\neg p_{stereo.possible}$. Possibility configurations can be narrowed down through exchange of related beliefs by discourse participants as to whether there is positive evidence for the prejacent and for the prejacent's complement, or, if their knowledge allows, by whether they are epistemically necessary (entailing truth) or impossible (entailing falsity).

In this way, epistemic modals enable individuals to refine the common ground with respect to a proposition of interest through a systematic discourse process even when no participant of the discourse event possesses the knowledge necessary to determine whether that proposition is true or false. The making of and the interpreting of epistemic modal assertions are tripartite processes in which semantics, the common ground and the Cooperative Principle all play distinct but integrated roles. An adequate accounting of such a process can only be achieved through an understanding of the interface between all three components.

要旨(Abstract)

　本論文の目的は認識的法助動詞である may/might 及び must による言明が伝達するコミットメントを特定し、そのコミットメントがどの点において異なるのか、どの点において類似するのか、また前後の談話によってどのような影響を受け、談話に展開にどのように影響するのかを説明することである。本論文に含まれる提案は、発話時において、協調の原理（Cooperative Principle、以降 CP）(Grice, 1989)に導かれ、認識的なモーダル命題の意味論的意味(Kratzer, 1977, 1981, 1991, 2012)が共通の土台（common ground、以降 CG）(Stalnaker, 1973, 1978, 1996, 2002)に含まれるビリーフとどのような相互作用をするのかの説明を試みたものである。

　モーダル言明の命題内容は、CP の量的要求によりモーダル・ベースを経由して系統的に規制されることを示す。量的要求を考慮することによって、真理条件のみで予測されるより多くの情報が共通の基盤に加わることが予測されることになる。これは、経験的に適格な真理条件の特定、モーダル言明の主観性と客観性の区別、モーダル言明に対する聞き手の同意・不同意に関する事実、モーダル文がどのような環境において埋め込まれうるかということに関する事実、「提案する」という発話行為の仕組み等、認識的モダリティを巡る中心的な多くの取り組みにとって示唆を与える。

　可能世界理論を用いた意味論では、認識的モーダル文の中に埋め込まれた命題(以降 prejacent と呼ぶ)が話し手の知識に関して可能・必然であることを意味する。Stalnaker の言明(assertion)のモデルでは、言明は言明された命題の真理条件的内容を共通の基盤に加えるための提案である。そのため、モーダルの命題の言明を受入れることが「prejacent が話し手の知識に関して可能・必然である」ことが CG に加わることに帰結するはずである。また、談話の他の参加者の prejacent に対するコミットメントに関わる変化には帰結しないはずである。しかし、実際においてはそうはならない。

　　(1)*There's a knock at the door,*　"That may/must be Bob." --　"I see. ?I doubt it."

　聞き手は I see を発話することによって話し手の命題を受入れることを合図する。次に、二つの文を発話する間に新しい知識を得ていないことを想定し、prejacent が疑わしいということを言明すること

によって自分自身と矛盾してしまう（尚、特に有標なイントネーションの場合に may は疑念を表すこともある。ここではその解釈は関心の対象ではない）。つまり、経験的には、モーダル言明の受け入れによって CG に加わると捉えられているのは「prejacent が話し手の知識に関して可能・必然である」だけではないということである。理論的な想定に反して、受け入れた本人の知識に関する prejacent のステータスにも変更を及ぼしたと捉えられているのである。

　一般的には、言明は、言明された命題の内容に対する公的なコミットメントであり、公言された事実により、聞き手にもその内容に対してコミットすることを促すものであるというように捉えることができる。我々は、話し手のモーダル言明の受け入れが聞き手自身のビリーフにも変化を及ぼすと捉えている事実を考えると、話し手の言明を、自分の知識に関する prejacent の必然性・可能性以外の要素も含むコミットメントとしている解釈していると考えられる。そこで生まれる疑問は「モーダルの命題を言明することによって話し手は何に対してコミットをしているのだろうか」ということである。

　この問いを追究する方法の一つとして、極性疑問文と非モーダル言明におけるモーダル言明との類似点・相違点、を特定することが挙げられる。標準的な可能世界流の意味論において、must のような必然性を表す演算子は、認識的な解釈においては、話し手が知っていることに関して prejacent が唯一の可能性であることを表すとされる。これは、話し手は prejacent が真であることを知っていることを含意する。従って、must は、言明された命題が真であることを意味する非モーダル言明と一見類似している。

　May/might のような可能性を表す演算子は、認識的な解釈において、話し手が知っていることに関して prejacent が真でも偽でも在り得ることを表す。従って、may/might は、聞き手が問われている命題が真であるか偽であるかを知らないことを表す極性疑問文と一見類似している。しかし、これら二点の類似点によって、話し手が may/might と must を言明することによってコミットする内容がうまく捕らえられるとは言えない。

(2) 疑問： 　　　　　　　　Did John leave already? 　　　　　　No, he didn't.

(3) 可能性の言明： 　　　　John may have left already. 　　　　! No, he didn't.

(4) 必然性の言明：　　　　John must have left already.　　　　!! No, he didn't.

(5) 非モーダルの言明：　　　John left already.　　　　　　!!! No, he didn't.

　上記の4つのやり取りにおいて、感嘆符の数で表記されている通りに、発話された命題に対する否定が段階的に対立性を増していく。疑問文は真であることに対しても偽であることに対してもコミットメントを表さず、非モーダルの命題は真であることに対するコミットメントを表すというように、John left already に対するコミットメントの、強さの度合に違いがあるようである。(2)～(5)の間で認識される(3)、(4)が疑問文より強いので、may/might と must は John left already に対して何らかの肯定的なコミットメントを表すことわかるが、非モーダルの言明より弱いので、真であることへのコミットメントを表さないということもわかる。そこで生じる疑問は「命題が真であること以外に話し手は何に対してコミットできるのだろうか」ということである。

　Kratzer は、(4)と(5)の違いを説明することを動機の1つとして、人的(human)モダリティの意味論を提唱している。この枠組では、認識的 may/might やは「標準的な(stereotypical)可能性」を表す。May/might が表す「標準的な可能性」において prejacent が認識的に可能なだけでなく「認識的に可能かつ標準的な成り行き」である。一方、must は唯一の認識的に可能かつ標準的な成り行きであることを意味する「標準的な必然性」を表す。Kratzer の提案下ならば、認識的モーダルの言明によって伝達されるコミットメントは prejacent の標準的可能性・必然性に対するものであると仮定できる。これは必然性の場合はうまくいくが、可能性の場合は問題が生じる。

　次のことを想定する：ジョンは他の予定がある場合に John left が標準的な可能性であり、パーティーで気になっている女性がいる場合に John did not leave が標準的な可能性である。(4)を真である命題として発話するためには、話し手はジョンに他の予定があることを知っている必要があり、逆にジョンが気になっている女性がいることを知ってはいけない（尚、事実としてはいてもいなくても良い）。一般的には、聞き手が人的必然性の言明の命題内容から帰納できるのは、話し手は prejacent に対する肯定的な証拠を持っており、prejacent の対義文に対する肯定的な証拠がないと信じているということである。必ずしも prejacent が真であることに対するコミットメントではないが、肯定的なコミットメ

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ントであることに変わりはない。しかし、この場合でも、「話し手の知識によって prejacent に対する肯定的な証拠があり、prejacent の対義文に対する肯定的な証拠がないことを受け入れることが聞き手の、prejacent に対するコミットメントに転用されるのはなぜなのか」という疑問が残る。

さらに、(3)に関しては採用している意味論は肯定的な証拠を要求しないという課題がある。(3)が偽であるのは、話し手が prejacent が偽であることを知らない限りにおいては、John did not leave が人的に必然である場合のみである。つまり、話し手は John が気になっている女性がいることを知らない限り真である命題として(3)が発話できるのである。一般的には、真である人的可能性の言明から聞き手が真理条件に基づいて帰納できるのは、話し手が prejacent が標準的な成り行きであることと矛盾する知識（この場合、ジョンが気になっている女性がパーティーにいる知識）を持っていないということのみである。

このように、真理条件上、may のモーダル命題を真である命題として発話するための十分条件が話し手の知識の欠如であり、may の言明が prejacent に対して肯定的なコミットメントを含意しないはずである。従って、人的モダリティでも可能性の言明が極性疑問文より強いコミットメントを表す理由を提供しないのである。可能性において、話し手のコミットメントを聞き手のコミットメントへ転換させる前に、話し手のコミットメントの所在を特定する課題があるのである。

量の要求を考慮に入れることで、モーダルの言明によって話し手のどのようなコミットメントが伝達されるか、また話し手の知識に基づく prejacent に対するコミットメントが CG において聞き手の prejacent に対するコミットメントに転用される仕組みがどのようなものかという二つの問いがともに解決できる。話し手が CG を更新しようとしているという CP に基づく聞き手の期待により、聞き手は話し手が使用するモーダル形式の意味に基づき非モーダルの語用論的前提（即ち、話し手がコミットしているとして聞き手によって捉えられている非モーダルの命題）が抽出できることを提案する。

語用論的な前提の抽出過程は CG の状態に依拠する。量の規則を維持しつつ言明を行うためには、話し手は自分の命題が CG に貢献できると信じていなければならない。CG はある命題が真であることも偽であることも可能であることしか含意しない場合、人的モダリティの言明によってその命題に対する肯定的な証拠が存在するというビリーフを加えることができる。聞き手は話し手に、量の規則

を守っていることを期待するため、モーダル言明を行った話し手に自分が肯定的な証拠を持っていると信じているということも期待する。

　人的必然性の場合、上記の期待は話し手の自分の知識に関するモーダルのコミットメントが、協調の原理により、実際の世界に関する非モーダルのコミットメントとして解釈されることに帰結する。一方では、可能性の<u>命題</u>は真である条件として話し手の知識の欠如で満たされるが、可能性の<u>言明</u>は共通の土台を更新しなければならないため、聞き手は、話し手が prejacent に対する肯定的な証拠を持っていなければ人的可能性を言明しないと想定する。言明を、話し手がこのような肯定的な証拠を持っていることのシグナルとして捉えた上で受け入れるならば、聞き手も CG において prejacent に対する肯定的な証拠が存在するというビリーフにコミットすることになる。このように、量の規則に規制された人的モダリティの意味論はモーダルの言明を行うことにより話し手が伝達する自分の肯定的なコミットメントと、そのコミットメントが CG において聞き手のコミットメントへ転用される仕組みの説明ができる。

　必然の言明により、話し手は prejacent に対して肯定的な証拠があり、prejacent の対義文に対しては証拠がないことにコミットする。つまり、話し手のコミットメントとして捉えられる二つの非モーダルの語用論的前提を生み出すのである。可能性の言明により、話し手は prejacent の対する肯定的な証拠があることにコミットするが、その対義文に対してはコミットしない。つまり、可能性の言明も話し手のコミットメントとして捉えられる非モーダルの語用論的前提を生み出すが、コミットメントを伴わない語用論的前提も生み出すのである。

　prejacent に対して一つ、prejacent の対義文に対して一つ、モーダルの言明によって発生されるこれらの 2 つの語用論的前提は談話において「モーダル・イシュー」を挙げる。モーダル・イシューは CG に関するある命題の可能な「可能性の配置（possibility configurations）」を絞り込もうという申出として解釈できる。人的モダリティの意味論では、ある命題とその対義文は両方とも標準的に可能であることが許される（例えば、他の予定あるため John left が標準的に可能であると同時に、気になっている女性がパーティーにいるために非標準的に可能でもある場合）。これを含め、命題とその対義文で形成される 5 つの可能性の配置が可能である：[1] $p_{impossible}$ & $\neg p_{epi.necessary}$ [2] $p_{epi.necessary}$ & $\neg p_{impossible}$ [3] $p_{astereo.possible}$

& ¬$p_{stereo.necessary}$ [4] $p_{stereo.necessary}$ & ¬$p_{astereo.possible}$ [5] $p_{stereo.possible}$ & ¬$p_{stereo.possible}$。 可能性の配置を絞り込む方法として、prejacent に対する肯定的な証拠があるか、prejacent の対義文に対して肯定的な証拠があるか、または談話参加者の知識が十分である場合、認識的に必然（真であることを含意する）であるか、不可能（偽であることを含意する）であるかを巡る談話参加者同士の関連ビリーフのやりとりが挙げられる。

　このように、認識的モーダルは、人に関心ののある命題に関して、当該の談話イベントの参加者の誰もが真であるか偽であるかを決定づけるための十分な知識を揃えてない場合に、体系的な談話過程を通してその命題に関して共通の土台を精緻化することを可能にする。認識的モーダルの言明や解釈は、意味論、共通の土台、協調の原理が別々ではるが統合された役割を果たす三部から成る過程である。そのような過程の妥当な説明は三部の間の接触面を把握する以外、達成できないのである。

<キーワード> 認識的モダリティ、量の格率、共通の土台、標準的オーダリング・ソース、可能性

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Introduction

0.1 Modality

In our everyday lives, we often find it necessary to talk about things we believe are likely to occur or to have occurred, things we want, things we need, things we are aiming for, etc. One characteristic which all of these "things" share is that they have not necessarily come to be, nor ever will have come to be; in a sense, they are 'unreal.' When we talk about them, we are making use of our signature human ability of displacement.

Modality is a notional, as opposed to a grammatical, category for expressing such states of affairs. Its coherence as a notional construct is evinced by a cross-linguistic tendency for these concepts to be expressed by morphologically related groups in each language (c.f. Matthewson, 2017). Modality has been the topic of descriptivist (Quirk, Greenbaum, Leech, & Svartvik, 1985), typological (Bybee, 1995; Narrog, 2012; Palmer, 2001), cognitive, and formal studies of language. There is no doubt that these various approaches disagree on how to delineate the category they are addressing in many ways, but 'unrealness' is one defining characteristic on which they all agree.

There are different reasons we would want to talk about things which are unreal, and modals can be divided into flavors which correspond different reasons: epistemic modality deals with whether things are in line with some body of knowledge, deontic modality deals with whether things are in line with some body of rules or laws, bouletic modality deals with whether things are in line with some body of desires, teleological modality deals with whether things are line with some body of goals, and so on[1]. The lexical items of a language will categorize these flavors in various ways.

Among those flavors, the focus of this dissertation is epistemic modality, and in particular the sentential operators *must*, *may* and *might*, which are said to express it. Expressions of epistemic modality are typically used when an individual does not know whether a given proposition is true or false, and categorize that proposition within the space between truth and falsity according to whether the speaker's knowledge permits or entails that it be true. However, as expressions of language, *must* and *may/might* are expected to communicate something to others.

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[1] See (Narrog, 2012) for an overview of different ways of categorizing modal flavors.

However, the hearer cannot feasibly know the contents of the speaker's knowledge, and so what meaning can a categorization based on the private knowledge of the speaker communicate to the hearer?

The mechanism by which a categorization based on an individual's private knowledge can become new knowledge for other individuals, or whether the assumption that the categorization is truly based on the speaker's private knowledge, has been a persistent theme of investigation in the epistemic modality literature. This dissertation aims to uncover the workings of that mechanism.

0.2 Epistemic modality in discourse

Specifically, the object of this dissertation is to identify the commitments communicated by assertions using epistemic *may/might* and *must*, and explain how they are different from one another, how they are alike, and how they are affected by and help shape the surrounding discourse. The proposal within consists of an account of how the semantics of epistemic modal propositions (Kratzer, 1977, 1981, 1991, 2012) interact with the assumptions contained in the common ground (Stalnaker, 1973, 1978, 1996, 2002) at the time of utterance, as mediated by the Cooperative Principle (Grice, 1989).

I show that the propositional content of modal assertions is systematically constrained, in terms of the modal base, by quantity demands. Factoring in the quantity demand results in modal assertions adding more to the common ground than would be predicted based on their truth conditional content alone. This has implications for many key areas in the literature on epistemic modals, including finding empirically adequate truth conditions for them, the nature of the intuition-based differences in subjectivity and objectivity of modal assertions, facts concerning agreement and dissent to a modal assertion by the hearer, embeddability of modal sentences, and proffering speech act effects.

According to possible worlds semantics of epistemic modals, epistemic modals denote that their embedded proposition (called **the prejacent**) is possible or necessary relative to Speaker's knowledge. According to the Stalnakerian model of assertion, an assertion is a proposal to add the truth conditional content of the asserted proposition to the common ground. As such, accepting an assertion of a modal proposition should result in "the

prejacent is possible/necessary according to Speaker's knowledge" being added to the common ground. This should not result in any change in commitment toward the prejacent by other discourse participants. However, this is not what actually happens.

(1) *There's a knock at the door*

"That may/must be Bob." -- "I see. ?I doubt it."

Hearer indicates that she accepts Speaker's modal assertion by uttering "I see." Then, given that she has not gained new knowledge between uttering the two sentences, she contradicts herself by asserting that the prejacent is doubtful (*May* can sometimes express doubt, especially when pronounced with marked intonation. We are not concerned with that reading at the present time.) That is, empirically, what is taken to be added to the common ground by accepting a modal assertion is more than just "the prejacent is necessary/possible according to Speaker's knowledge". It is taken to change the prejacent's status relative to the acceptor's knowledge, contrary to the theoretical expectations.

In general, an assertion can be taken as a public commitment by Speaker to the content of the asserted proposition which, by virtue of having being publicized, will prompt Hearer to also commit to it. Since we perceive that Hearer's accepting Speaker's assertion changes Hearer's own beliefs regarding the prejacent, we must be interpreting Speaker's assertion as a commitment to more than just the prejacent's status relative to his own internal knowledge. What is Speaker committing himself to by uttering a modal assertion?

An investigation of this question can start by identifying the similarities and differences of modal assertions with non-modal assertions and questions. According to standard possible worlds semantics, necessity operators like *must*, when interpreted in their epistemic sense, express that the prejacent is the only possibility given what Speaker knows. This would entail that Speaker knows that the prejacent is true. In following, *must* can be compared with non-modal assertions, which denote that the asserted proposition is true.

Possibility operators like *may/might*, in their epistemic sense, express that the prejacent may be either true

of false according to what Speaker knows. In following, *may/might* can be notionally compared with polar questions, which also express that the speaker does not know if the proposition being asked is true or false. However, neither of the above two comparisons adequately captures what Speaker commits himself to by virtue of *may/might* or *must* assertions.

(2) Question:	Did John leave already?	No, he didn't.
(3) Possibility assertion:	John may have left already.	! No, he didn't.
(4) Necessity assertion:	John must have left already.	!! No, he didn't.
(5) Non-modal assertion:	John left already.	!!! No, he didn't.

In the above four interactions, a rejection of the uttered proposition by Hearer is increasingly confrontational, indicated by the number of exclamation marks. There seems to be a rough gradient of strength of commitment toward "John left already" expressed by Speaker, where questions express no commitment to either truth or falsity and non-modal assertions express commitment to truth. The gradient in perceived strength among (2)-(5) suggests that, unlike questions, *may/might* and *must* both do express some positive commitment by Speaker to "John left already", but unlike non-modal assertions, one which is not to its truth. <u>But what can Speaker be committed to if he is not committed to the truth of the proposition</u>?

In answer to this question, many researchers have resorted to non-truth conditional stipulations. Halliday (1970, p. 349) wrote that modality is "external to the content [of the sentence]" and reflects the "attitude taken up by the speaker." Lyons (1977) opted to give epistemic modals a specialized speech act, describing their use in indicative sentences as hedged assertions, showing a weaker commitment on the part of Speaker than a non-modal indicative sentence. Given this, the difference between a possibility assertion and a necessity assertion, as above, would be the strength of the assertion, but they would have the same truth conditions as non-modal propositions.

However, as has been pointed out by formal semantics work (cf. Papafragou, 2006; von Fintel & Gillies, 2007), this leads to problems when computing the compositional meaning of sentences. Consider the following.

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(1) Mom said that if it might rain tomorrow, we're not going to the beach.

A conditional sentence like (1) connects an antecedent with a consequent by a logical connector which denotes that the sentence is false if and only if the antecedent is true and the consequent is false. In (1), we can observe that whether it is certain that it will rain or not, as long as there is a possibility that it will rain tomorrow, and they do go to the beach, what "Mom" said is false. This shows that, at least sometimes, epistemic modals contribute to the content of a sentence. Thus, a semantics which is distinct from non-modal propositions is necessary.

Kratzer proposed a "human" modality semantics, in part to account for the difference between (4) and (5). Within this framework, epistemic *may*/*might*, along with many other natural language lexical items which express that an embedded proposition is possible, denote "stereotypical" possibility. A stereotypically possible proposition is more than just epistemically possible, it is an epistemically possible "normal state of affairs." Meanwhile, *must* denotes "stereotypical necessity," which means that the prejacent is the <u>only</u> epistemically possible "normal state of affairs." If we accept Kratzer's proposal, we might suppose that Speaker positively commits himself to stereotypical possibility/necessity by making epistemic assertions. This works well for necessity but runs into problems with possibility.

Suppose that "John left" is a normal state of affairs if John has other plans, but "John did not leave" is a normal state of affairs if there is a girl he likes at the party. In order to utter (4), Speaker must know that John is tired and cannot know that there is a girl John likes at the party (in reality, there may or may not be one). In general terms, Hearer can deduce that Speaker has positive evidence for the prejacent, and that he believes that there is not any positive evidence for the complement of the prejacent. This does not entail a commitment to the prejacent being <u>true</u> but is nonetheless a positive commitment toward it. However, the questions remains <u>why Hearer's accepting that there is positive evidence for the prejacent and no positive evidence for the prejacent's complement according to Speaker's knowledge should translate to a commitment by Hearer to the prejacent.</u>

There is an additional hurdle for (3). Our semantics does not require even any positive evidence. The only way

for (3) to be false, given that Speaker does not know that the prejacent is false, would be if "John did not leave" were humanly necessary. This means that Speaker can truthfully utter (3) as long as he doesn't know whether there's a girl at the party that John is interested in. In general terms, the only thing Hearer can deduce from a true human possibility proposition is that Speaker does not know anything that contradicts the prejacent being a normal state of affairs (e.g. there being a girl John is interested in at the party).

Since semantically all that is required to utter *may* is a lack of knowledge, there appears to be no reason why Speaker would have to be interpreted as having a positive commitment toward the prejacent by uttering a *may* assertion, and so human modality does not offer explanation for why possibility assertions should express a stronger commitment than polar questions. For possibility, even before pursuing the question of how to translate Speaker's commitment to a commitment by Hearer, we have the problem of finding a commitment by Speaker at all.

Both the question of what commitments of Speaker are expressed by modal assertions, and of how commitments to a prejacent based on the contents of Speaker's internal knowledge can translate to commitments to the prejacent by Hearer in the common ground can be answered by factoring in the quantity demand. I propose that, based on Hearer's expectation, as per the Cooperative Principle, that Speaker is trying to update the common ground, Hearer can derive non-modal pragmatic presuppositions, i.e. non-modal propositional beliefs to which she takes Speaker to be committed, based on the semantic properties of the modal forms he uses.

The process of derivation of pragmatic presuppositions is affected by differences in the common ground, and so many predictions about how Speaker and Hearer will behave can be made based on characteristics of the common ground. These predictions offer insight into when and why Speaker provide verbal evidence, when and why Hearer argues with epistemic modal assertions, why an epistemic modal assertion, in particular a possibility assertion, is informative, why Speaker can appropriately make a given modal assertion to one person but not to another, what makes a modal assertion feel "objective" and what makes it feel "subjective," and why some modal assertions seem 'wrong' but not really false, while others seem clearly false.

The following are the main questions of this dissertation.

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I. What is the role of the semantic denotation of a modal sentence, of the common ground at which the modal

    sentence is uttered, and of the Cooperative Principle in determining the discourse meaning of the utterance?

II. What is the nature of the commitment expressed by *must* and *may/might* in assertions?

    A) What do epistemic possibility/necessity assertions contribute to the common ground?

    B) How does the common ground affect the appropriateness of a modal assertion?

    C) What effects do modal assertions have on the discourse event in which they are uttered?

0.3 Chapter overview

    Chapter 1 is intended as an introduction to the tripartite pragmatic system integrating semantic meaning, the

common ground and the Cooperative Principle which is used to analyze modal assertions in this dissertation. I argue

against what seems to be a tacit agreement that the quality maxim is procedurally prior to the quantity maxim.

    It focuses on the notion of possibility as expressed by the English modal verbs *may/might*. Possibility

assertions are usually informative in discourse, that is they refine the beliefs of other participants regarding the

prejacent (i.e. the proposition embedded under the modal), but standard definitions of possibility, taken here to be

represented by DeRose (1991), do not provide a systematic way to derive information from a sentence denoting

possibility. As a solution, I introduce possible worlds and Kratzer's human modality framework, which is relative to

two types of information, knowledge and normal states of affairs. I show that human modality semantics provides

the underpinnings for an informative interpretation, and that if we allow the quantity to determine the minimum

requirements for the contents of Speaker's knowledge (i.e. modal base) in order to make a felicitous assertion, that

Hearer can always deduce that Speaker has some kind of positive evidence for the prejacent.

    Chapter 2 is dedicated to making evident the validity of Kratzer's human modality semantics for

epistemic modals. In 2.1, I show that double-relativity is needed to account for entailment and contradiction

patterns in discourse events. I also show that double relativity is needed to account for the perceived different in

strength between epistemic necessity assertions and non-modal assertions. I then propose a Kratzerian denotation

for *may/might* and *must* where they can be used to express both contextual and human modality depending on

whether the ordering source is empty or stereotypical.   In 2.2, I demonstrate the need for an ordering source in epistemic modality and characterize the contents of a stereotypical ordering source.

Chapter 3 is dedicated to showing how Kratzer's human modality and Stalnaker's common ground fit together once the quantity maxim is factored in. In 3.1 I show that given only Kratzer's human modality and Stalnaker's model of discourse and assertion, epistemic modal asserts should not cause any change to the beliefs of other discourse participants, but that, empirically, they do.

In 3.2, I introduce previous approaches to address the discourse affects of epistemic modals which cannot be explained by their propositional content. In 3.2.1, I introduce the literature dedicated to finding empirically adequate truth conditions for epistemic modals, focusing on suggestions on how to expand the domain of the modal base.   In 3.2.2, I introduce the key pragmatic issues in epistemic modality research such as proffering the prejacent as answer to a question, intuition-based differences in the subjectivity and objectivity of modal assertions, and the theoretically unexpected regularity of agreement and dissent.

I review (Portner 2009)'s common propositional space (CPS) and Swanson (Swanson 2006)'s course and fine-grained information space as attempts to address the proffering effects. I introduce (von Fintel & Gillies, 2011)'s cloud of contexts as a way to account for agreement and dissent. I conclude that, rather than splitting the problems into parts and solving each part with different proposals, a united solution capturing both Speaker's positive commitment to the prejacent and the intersubjective aspect is necessary.

In 3.3, I make my proposal. I propose that epistemic modal assertions are proposals to update the common ground by changing the possibility configuration of the prejacent relative to the common ground. I then show what is logically needed to do so, that a possibility configuration based on Speaker's internal knowledge can be translated to the common ground, and that Hearer can systematically derive non-modal pragmatic presuppositions from the denotations of human modal expressions because she expects Speaker's modal base to satisfy the quantity maxim.

In 3.4, I detail the process deriving the pragmatic presuppositions described in 3.3. I then enumerate a variety of predictions that can be made about how modal assertions interact with the common ground based on

the derivation process. In 3.5, I show that adequate truth conditions, the proffering effect, the intuition-based differences in subjectivity and objectivity, the target of Hearer agreement and disagreement with modal assertions, some embeddablity issues, and the nature of the commitment made by modal assertions can all be explained using the predictions made by the pragmatic presuppositional approach in 3.4.

Chapter 4 is dedicated to demonstrating the social reality of the pragmatic presuppositions. I propose that since a modal assertion introduces two pragmatic presuppositions, one for the prejacent and one for its complement, it introduces a special kind of issue, a "modal issue", to the discourse floor. I employ the Stalnakerian discourse model developed in (Farkas & Bruce, 2009) to highlight the negotiation process which occurs before proposed changes to the common ground are seen through. I show that the result of settling a modal issue results in possibility configurations in the common ground which no single utterance denoted, but which are predicted by the pragmatic presuppositional approach for which I am advocating.

In the conclusion, I conclude that modal assertions are manifestations of the interaction between three distinct but highly-integrated systems: grammar, the common ground and the Cooperative Principle. Unless we understand the contribution of each system and how those contributions come together, we cannot hope to explain the behavior of modal assertions in discourse.

Chapter 1 A bird's eye view: *May/might* in discourse

1.1 Interpreting an utterance in discourse: Grammar, the cooperative principle, and common ground

I shall begin this chapter by sketching a general picture for how an utterance is chosen and interpreted in discourse. Discourse will be taken as a tripartite pragmatic system. This is the central assumption of the author in regards to language in discourse and will be central in the analysis of modal utterances developed in this dissertation.

In order to analyze the meaning of an uttered sentence in discourse, there are three different systems we must take into account: grammar, the cooperative principle, and the common ground. First, we must consider the sentence's grammatical structure. Each sentence has a phonological structure, a syntactic structure, and compositional truth conditions. The internal restrictions of each of these systems act as co-restrictors on one another. A well-formed, or grammatical, sentence is one which obeys the restrictions of all of these systems. However, the grammatical structure of an uttered sentence is not sufficient to make sense of a sentence in discourse. In particular, truth conditions often have features built in for interacting with discourse structures[2]. Thus, truth conditions of a sentence are only one part of the pragmatic system through which Speaker and Hearer situate an utterance in a discourse event.

The second component of this system is the Cooperative Principle (CP). When someone utters a sentence to us, we reflexively come to believe that they want to communicate something to us, and that they expect us to try to understand what they have communicated. This belief may stem from the fact that we would also want to communicate something if we uttered something to someone, and we would also expect them to try to understand what we have tried to communicate. This system of mutual belief leads to a coordination of efforts among all participants in a communicative event. The linguistic philosopher Paul Grice (1989) titled the principle behind this coordination the cooperative principle of conversation (henceforth CP). Successful communication through utterances depends on both the grammatical structure of sentences and the cooperative principle.

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[2] For instance, "I can swim," can only make sense if we have a context to pick out who "I" is.

The third component is the common ground. As members of a human society, we have beliefs about what we know ourselves and what others around us know. We also know that what we know is not the same as what others know. This might be characterized as "private" versus "common" belief. When we interact, we try to influence the common belief. The set of common beliefs among the participants of a given linguistic interaction is referred to as the common ground[3]. The first person to describe the relation to discourse of this distinction between private and common belief in a systemic, formal way is Stalnaker (1973, 1978, 1996, 2002).

For Speaker, a necessary condition for feeling the need to communicate his belief is the belief that Hearer does not have this belief. Hearer, since she also is sometimes the utterer and thus has experienced the same predicament, will believe that Speaker believes this and will expect his utterance to contain new information for her, or minimally, information which he believes is new for her. Speaker is also sometimes the Hearer, and so he expects Hearer to expect that his utterance contains new information. This is a manifestation of the CP. Thus, an utterance is chosen and interpreted in part based on how one perceives the state of the common ground. If Hearer uptakes the information from Speaker's utterance, it updates the common ground.

A successful communicative utterance can be characterized as a step in an ongoing process, regulated by the cooperative principle, of adjusting the common ground by using grammatical structures, or sentences. Throughout this paper, the words, "discourse" and "conversation" will be used to refer to this process. Discourse is a powerful system of communication because the systematic constraints on how it is carried out are known and, under normal circumstances, obeyed by all participants. Consider the following:

(2)   *Hanako and John are neighbors. Hanako knows John's mother has forbidden John from going to the school prom because he failed his test, but Hanako really wants him to go to the prom with her. As a favor to his mother, Hanako has just finished cleaning her house, so she believes the mother is very thankful to her. Hanako and John's mother have the following conversation.*

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[3] It also includes "beliefs" which participants don't truly believe but treat as true for the purposes of the conversation, and so the common ground is not precisely equivalent to common belief.

Hanako: I really wish John was coming to the prom.

John's mother: Well, if YOU want him to go, he may go.

In the above dialogue, John's mother assumes Hanako is saying that she wishes John was not forbidden from going to the prom. Furthermore, she takes Hanako's assertion as a hint that she wants her to give John permission to go. In these circumstances, Hanako will interpret *may* as a deontic *may* giving John permission to go to the prom as a favor to her.

(3)   *This time, John is not forbidden from going to the prom, but Hanako knows he hates proms and hasn't been able to ask him to go. John's mother and Hanako have the following conversation.*

"I really wish John was coming to the prom. "

"Well, if YOU want him to go, he may go."

This time, since John is already allowed to go to the prom and Hanako knows this and John's mother knows that she knows this, a deontic reading of *may* is not chosen. First, since Hanako has no need to get John's mother to give John permission, but they both know about John's hate for proms, John's mother assumes that Hanako is saying that she wishes John would get over his hate for proms and is perhaps digging for hints on how to get him to go. In this context, the same exact sentence has a completely different interpretation. Hanako will interpret *may* as an epistemic *may*, saying that John is likely to go to prom for some reason known to John's mother. Perhaps she knows that John has a big crush on Hanako.

Given the uttered sentence alone, the epistemic (prediction) and deontic (permission) interpretations are both possible. However, if the utterance is to update the common ground, the options are restricted. In the first situation described, the common ground includes that John cannot go to the prom, and Hanako adds that she wants him to go, indicating that she wishes for a common ground where John is allowed to attend the prom. Both John's mother and Hanako are aware of this situation, and so John's mother knows that her *may* will be

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interpreted as a *may* of permission and not of prediction. Hanako also knows that John's mother will make her utterance in such a way that it updates the common ground, and that she has just indicated how she wants the common ground to be updated, so she expected John's mother to make a contribution that will do so. The common ground is thus updated to include "John has permission from his mother to go to the prom."

In the next example, the common ground is different than in the first situation, and in particular the fact that John has permission to go is already common ground. However, this time it is common ground that it is unlikely that John will go to the prom. In this situation, Hanako does not interpret *may* as a permission *may*. She knows John has permission and knows his mother knows she knows this. However, they both know that John's mother, being as she is his mother, knows a lot about John. Thus, they both know that a prediction reading of *may* will be helpful for Hanako, giving her a hint on how to grant her wish. In this case, the common ground will likely be upgraded to include something like, "John has a crush on Hanako." Thanks to the interplay of the CP and the common ground, Hanako's mother can confidently use *may* and Hanako can confidently interpret *may* even though it is semantically ambiguous.

However, the effects of the tripartite system are not always so apparent. In this study, I will show how the CP and the common ground interact with the truth conditions of epistemic modal sentences, which semantically need not be informative, to ensure that they are given an informative reading. We will see that the constraints of the common ground and CP demand a logical link between two components of an uttered modal sentence's truth conditions[4] which is not required at the grammatical level. This logical link is precisely what allows Hanako to know John has permission in (2) and that John has a crush on her in (3). This will show how modal possibility assertions produce many of the observed discourse effects which current research tries to explain with extra semantic and pragmatic machinery.

This analysis will reveal not only when modal assertions are "true" and "felicitous," when and how they become common ground, and the nature of the information they communicate, but will also give new insight on how they work as response-mobilizing features to shape discourse development. Any explanation which does not

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[4] I am referring to the "modal base" and "ordering source," which will be explained informally in section 1.3 and fully in chapter 2.

take this full picture into account such as a purely semantic accounts will prove insufficient in accounting for modal expressions when they are examined in discourse.

I will be focusing on the English modal auxiliaries *may/might* and *must*. However, the framework should be easily applicable to any language which expresses possibility and necessity through modal expressions. This is because the framework within is nothing but a way of making explicit the implications of the generally-accepted assumptions about language in use described above.

I will show that many of the perceived gaps between use of modal sentences and current linguistic theory stem not from an underpowered or inaccurate theory of semantics or pragmatics, but from a failure to fully take into account how the semantics interacts with the CP and the the common ground over the course of a discourse. The common ground and the cooperative principle, being alike in that they are external to grammar, are often lumped together by linguistic researchers as "pragmatics," but keeping their roles separate will be essential in finding a precise analysis of modal utterances.

1.2 What does it mean to be a possibility?

According to DeRose's (1991) seminal paper on epistemic modality, "*p* [=any proposition] is possible if and only if no member of the relevant community knows that *p* is false" (p. 593). In other words, if Speaker, or alternatively, other relevant individuals or groups, know that *p* is false, then *p* is impossible. Otherwise *p* is possible. If we adopt this definition for possibility modals such as *may*, we must accept a number of incongruities between semantics and use in discourse.

First, let us consider in an informal fashion three stances Hearer is likely to have with respect to the propositions represented by (4)-(6). The stances just reflect possible internal belief states which are not necessarily gained through discourse. After, we shall examine what effects Speaker's asserting that those propositions are epistemic possibilities (as in (7)-(9)) can have on Hearer's stances.

(4) that it snowed in Tokyo in mid-July[5]   Stance: unlikely

(5) that Bob left already   Stance: possibly likely

(6) that it rained in South Africa   Stance: neither unlikely nor likely

Given well-known facts such as that snow usually only occurs during cold weather and that mid-July Tokyo is very hot, (4) is certainly unlikely, but it is not impossible unless you happen to know the weather for every day of mid-July and that it didn't snow on any of them. How about (5)? Imagine that you're at a party, and you're looking for Bob. Since you don't know where Bob is, the proposition may or may not be likely, but nevertheless you don't know that it is true or you would not be looking for him.

Now consider (6). Assume you are currently in some location whose residents are unlikely to have knowledge about the current weather in South Africa. Can you say that you know that it is not raining in South Africa? Can you even say that it is unlikely that it is raining in South Africa? The proposition seems to be possible in the same broad sense that (4) and (5) are, but there is also a decided intuitive difference in stance—in fact, we might say that there we have no stance regarding (6) other than it is possible in DeRose's sense.

Although our stances toward (4), (5), and (6) are alike in that we don't know whether the proposition is true or false, they also differ due to differences in what beliefs we have that we take to be related to them. These related beliefs may be specific to whatever the current situation is, such as not knowing where Bob is at the utterance time, or they may be general beliefs, such as knowing that snow doesn't typically fall in warm climates.

Is there any empirical motivation for or against disregarding these differences in stance (i.e., how they relate to what we know) so that all three propositions can be lumped together as "possible"? Language is an imperfect tool and is not supposed to perfectly represent an individual's thoughts. We would need empirical evidence that these stances play a role in discourse to motivate giving them linguistic expression in a theory of language use.

Below, (7)-(9) put the above propositions under the scope of an epistemic possibility modal. Imagine at what kind of scenes a friend might utter these sentences to you.

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[5] The *that* indicates that it is an unasserted proposition.

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(7) It may have snowed in Tokyo in mid-July.

(8) Bob may have left already.

(9) It may have rained in South Africa.

As we saw, (4) was unlikely but not impossible. However, if we accept (7), in some capacity we accept (4) as more likely than it was prior to the utterance. We get the idea that our friend has some reason to predict that (4) is true, (perhaps he read that it snowed on a marginally-trustworthy online social media website), and feel that it would be misleading for him to utter it otherwise. The same might be said of (5). It wasn't unlikely to begin with, but upon hearing (8) we come to believe that there is indeed some reason to predict that it is true. If we already thought it was likely, we might just agree with our friend. In any case, it would be misleading on the part of our friend if he did not have any such reason. Now consider (9). If a friend who also doesn't know anything about South Africa utters (9) to us, we may have trouble interpreting the utterance. We may be at a loss for why he would say such a thing in the first place. Unlike (7) and (8), the utterance would fail to be misleading even if our friend did not have a reason for predicting that (6) is true because we are not able to accept that she could have one in the first place. (9) is unlikely to give us a sense that we have gained new information.

In sum, we considered very likely contexts in which (4)-(6) are all "possible" in DeRose's sense. According to the typical Stalnakerian conception of assertions, asserting a sentence is an act of trying to get Hearer to accept it as true. In the case of (7)-(8), the *may* assertions clearly do more than reiterate that the prejacent is "possible." We also saw some indication that when Speaker makes a possibility assertion he assumes that Hearer does not already consider the prejacent likely. In contrast, (9) does not clearly do more than reiterate that the prejacent is possible. This should be perfectly acceptable if the role of *may* were restricted to indicating possibility in DeRose's sense but, in actuality, it is difficult to even imagine what role in discourse Speaker could have intended for it.

May sentences seem to either make a proposition that was already possible "more" possible, or fail to be an appropriate discourse move. Since there are countless propositions which we do not know are false but about which

we have no relevant beliefs, it follows that the number of propositions which can be used felicitously under the scope of possibility modals such as *may* in any given context are far fewer than the number of those which are semantically "possible" in DeRose's sense. Added to this, possibility assertions also seem to occur when Speaker assumes Hearer does not already consider the prejacent likely, so there are even fewer semantically-possible propositions that can be felicitously used with possibility modals. Thus, if the truth conditions of possibility operators such as *may* are as DeRose says, we must seek a non-semantic way to explain the empirical role of the three stances we saw in the above examples. However, it is also possible that possibility operators have different truth conditions. Thus, there are two possible approaches to finding an explanation for these observations.

A)   Change the truth conditions of *may* so that they entail more than just (DeRose) possibility

B)   Invent some kind of specialized pragmatic device which is conventionally triggered by *may*

There have been many endeavors to identify what epistemic modal assertions mean semantically and how they attain their meaning in discourse. Some focus on A) (Kratzer, 2012; MacFarlane, 2003; von Fintel & Gillies, 2010; Willer, 2013) and some focus on B) (DeRose, 1991; Lyons, 1977; Papafragou, 2006; Portner, 2009; Swanson, 2006; von Fintel & Gillies, 2011), but most agree that both are necessary, to varying degrees. This dissertation adopts Kratzerian ordering semantics, and as such has chosen A) and not B). Of course, Kratzerian ordering semantics alone does not provide an obvious explanation for epistemic modality in discourse or, presumably, more researchers would have adopted it.

The object of this dissertation will be to show how Kratzerian (1981, 1991, 2012) truth conditions interact with a Stalnakerian (1973, 1978, 1996, 2002) discourse model under the Gricean (1989) cooperative principle to predict the observations above and a large number of those from the literature without creating extra pragmatic machinery. It will show that the majority of possibility assertions are attempts to add to the common ground that there is reason to believe that the prejacent is part of a usual state of affairs which is compatible with the utterance context.

The new facts revealed by this analysis will require a careful examination of Grice's maxim of quantity, which demands that a "conversational contribution" be as informative as required, and the maxim of quality, which demands that the "contribution" not be false and be sufficiently justified. By quality, no matter how informative a proposition would be, Speaker must believe it is true in order to assert it felicitously. By quantity, not just any way for a proposition to be true is adequate for a felicitous assertion: it must contribute to a goal.

What is the goal? In the Stalnakerian model of assertion, a successful assertion results in adding a proposition to the common ground. In connection with this, (Stalnaker, 1978) proposes a principle for interaction between "context and content" such that an asserted proposition not be known to be true or false in the common ground. This is sufficient to assure that the addition to the common ground of any felicitously asserted non-modal proposition results in a change to the common ground, which is taken to be the basic goal of any assertion.

However, for assertions of possibility propositions, Stalnaker's principle does not offer an adequate accounting. Possibility assertions can be true due to a lack of knowledge or due to a possession of knowledge, but typically only the latter will require a change to the common ground. If felicitous addition to the common ground only requires that the asserted proposition not be known to be true or false in the common ground, a possibility proposition which is true due to a lack of knowledge will always be true, but its prejacent will also not be known to be true or false in most cases, and so there will be nothing to add to the common ground.

We will conclude that Stalnaker's framework alone is not adequately equipped for modal assertions; we will have to apply Grice's quantity maxim on top of Stalnaker's framework to reflect the linguistic fact that possibility assertions are usually informative. The resulting semantic-pragmatic interface will yield new predictions for how discourse involving modal assertions develops, which will be shown to hold in actual discourse.

In the rest of this chapter, I will explain the bare essentials for a basic understanding of Kratzerian modality and provide a bird's eye view of this dissertation's take on how Kratzer's truth conditions, Stalnaker's common ground and the Gricean CP fit together. Detailed formal analysis and comparison with alternative approaches will start in Chapter 2.

1.3 Possible worlds and Kratzer's proposal

Formal semantics typically uses a possible worlds model[6] to define meaning. In a possible worlds model theory, there are an infinite number of possible worlds, and each is a complete instantiation of the present, past and future of one humanly conceivable way the "world", which includes not just Earth but the entire universe, could be. Thus, the truth value of every conceivable, well-formed, uttered or eventually-uttered[7] sentence is determined at each possible world. This allows us to identify sentence meanings with a theoretical construct labeled "proposition." In possible worlds semantics, propositions are defined in terms of possible worlds.

There are two formally-equivalent ways to define a proposition, both of which will be used throughout this dissertation.

Function theory: A proposition can be viewed as a function which maps possible worlds to truth values. In this case, we would say, "proposition p is true at world w." A well-formed, uttered sentence can be said to express a function from possible worlds to truth values.

Set theory: A proposition can also be viewed as a set of worlds. In this case, we would say, "a world w is in/belongs to/is a member of proposition p." A well-formed, uttered sentence can be said to denote the set of worlds where it is true[8].

In Kratzer's proposal, the truth conditions of a modal proposition are relative first off to a modal base. The modal base takes a "conversational background" picked out by the context. A conversational background is a set of propositions. In addition to a conversational background for the modal base, we will also assume that the context picks out an individual. The "individual" could be a nation, a classroom, a person, or even a book. If the context

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[6] See (von Fintel & Heim, 2011) for an introduction to possible worlds semantics and (Dowty, Wall, & Peters, 1981) for an introduction to model theoretic semantics.

[7] Some sentences, such as those which include indexicals like "I," make essential reference to contextual entities, and so cannot have truth values until they are assigned a context (cf. Kaplan, 1989).

[8] As can be seen, according to set theory a proposition is a set of worlds, so it would be odd to say under that conception that a proposition is true at a world, i.e. true at one of its subcomponents. Thus, the relation between propositions and sentences can be more difficult to express linguistically in set theory than function theory. However, set theory has advantages when dealing with more abstract concepts. As is general practice in formal semantics literature, I will use both ways of reference. Function theory will be used when talking about the meaning of sentences and set theory will be used when it is necessary to make reference to the membership status of types of worlds.

picks an "epistemic" conversational background and Speaker as the relevant individual, the modal base is composed of the set of propositions which are known by Speaker. Other conversational backgrounds can be defined in a similar way. For example, a "deontic" conversational background is composed of the set of propositions which are expressed by the laws/rules of a contextually-chosen individual.

The intuition underlying DeRose's definition of epistemic possibility can be captured equally in Kratzer's framework. Before translating DeRose's definition, we must see how knowledge and possible worlds are related. By definition, at any given possible world, the truth value of every conceivable proposition is fixed. As residents of the actual world, we know many propositions to be true at the actual world. Even so, no individual can ever know the truth value for every proposition at a given world. Thus, for any given individual x, any possible world at which every proposition that x knows to be true (including negations of propositions) is true could as far as that person tell be the actual world. Additionally, since there are an infinite number of conceivable propositions, there is an infinite number of possible world candidates for the actual world.

Returning to DeRose's definition, any proposition p that an individual x doesn't know to be false is possible as far as x knows. There are two ways to satisfy this definition.

1. x knows p to be true.

    ● No $\neg p$-world, defined as worlds where p is false, could be the actual world according to what x knows.

2. x does not know whether p is true or false.

    ● Both p-worlds, defined as worlds where p is true, and $\neg p$-worlds could be the actual world according to what x knows.

Now we shall show how DeRose's definition and Kratzer's framework correspond. We will assume an epistemic modal base f. f is a set of propositions but, as above, epistemic possibility is only concerned with the worlds which could be the actual world, i.e. the worlds where all the propositions in f are true. We have two formal options for narrowing down the worlds over which possibility quantities. We could take f to be a set of propositions as functions and quantify over f to pick out the set of possible worlds in which every proposition in f is true. Alternatively, we could take f to be a set of propositions as sets of worlds and take the intersection of all of the sets in f, written as $\cap f$,

to pick out that same set of possible worlds. Kratzer takes the latter option, and so shall we.

We take $\cap f$, which is a single proposition, to be the set of worlds compatible with our modal base.. The worlds in $\cap f$ are called (epistemically) accessible worlds. Now we can define "possibility" and the related concepts of "necessity" and "impossibility" relative to $\cap f$. Modality relative to $\cap f$, i.e. the set of accessible worlds, will be referred to as "contextual" modality ' (since it cannot be defined without a context to pick out a conversational background as modal base and a relevant individual).

We shall refer to (a)-(c) in Figure 1 to give a visualization of the definitions.

Figure 1 Contextual Possiblity, Contextual Necessity, Impossiblity

(a) p and $\neg p$ are both contextually possible

(b) p is contextually necessary and $\neg p$ is impossible

(c) p is contextually impossible and $\neg p$ is contextually necessary
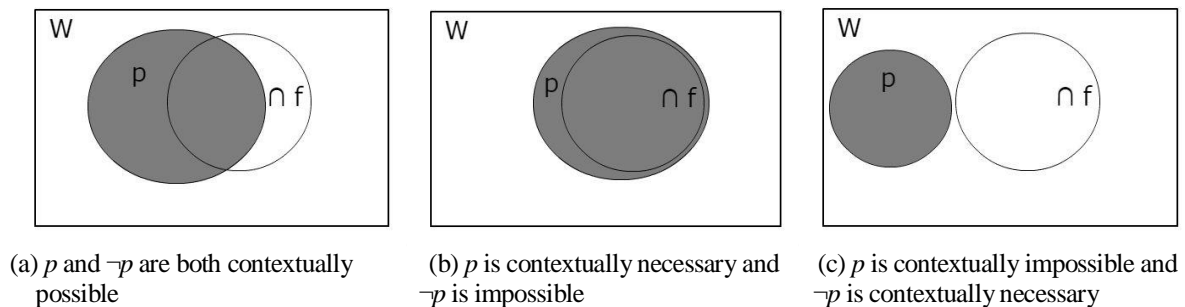
W, the white box, represents the set of all possible worlds. The gray circle represents p, the set of worlds where p is true. All worlds not in the gray circle are $\neg p$-worlds. The $\cap f$ circle represents the set of accessible worlds.

- In (a), both p and $\neg p$ are contextually possible. p has a non-empty intersection with $\cap f$, but it does not subsume $\cap f$ so we know that $\cap f$ includes $\neg p$-worlds as well as p-worlds. This corresponds to option 2 from above. Speaker doesn't know if p is true or not.

- In the second figure, p is both contextually possible and necessary, and $\neg p$ is impossible. p subsumes $\cap f$, so we know that no $\neg p$-worlds are included in $\cap f$. This corresponds to option 1 from above. Speaker knows that p is true.

- In the last figure, p is impossible and $\neg p$ is necessary. We see there are no worlds in common between p and $\cap f$, so we know that all worlds in f are $\neg p$-worlds. This corresponds to the case in which Speaker

knows that *p* is false.

● Given the above, *may p*, given a denotation representing the DeRosian definition of possibility, is true in the case of (a) and (b) but false in the case of (c).

So far, we have merely shown that DeRose's definition can be translated into Kratzer's framework. If we stop here, we have exactly the same problems we had in explaining (4)-(9) above. Despite differences in stance, (4)-(6) all correspond to (a), and they continue to correspond to (a) after the utterances in (7)-(9), despite a feeling that the stance has changed (or not, to Hearer's confusion, in the case of (9)). This is where the second part of Kratzer's proposal comes into play.

Kratzer's framework does more than DeRose's definition by allowing modality to be further relativized to an additional set of propositions, what she calls an ordering source. Like the modal base, the ordering source takes a contextually-selected conversational background, but it uses it differently. For epistemic[9] modal utterances, Kratzer proposes a "stereotypical" ordering source which works in combination with the epistemic modal base to pick out "likely", or "stereotypical," worlds. Roughly, those accessible worlds at which the largest number of "stereotypical" propositions are true are selected. This explanation of how the ordering works is oversimplified and blatantly incorrect in some cases as we will see later, but for the current purposes it is sufficient to understand that we are supposing a set of "maximally likely" worlds inside the set of accessible worlds. We will call this set the "max set".

Given this max set, we can redefine possibility, necessity and impossibility as relative to the max set instead of to the entire set of accessible worlds. Modality relative to the max set is referred to as "human[10]" modality.

Figure 2 Human Possibility, Human Necessity, Slight Possibility

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[9] In the classical Kratzerian conception, "epistemic" is contrasted with "circumstantial" modality, which is a cover term for root modalities including "deontic."

[10] I am not sure of the motivation behind this naming. Perhaps it is intended to imply that it is the modality which humans use most often.
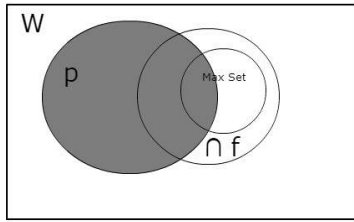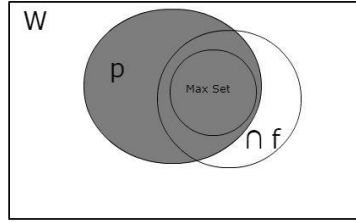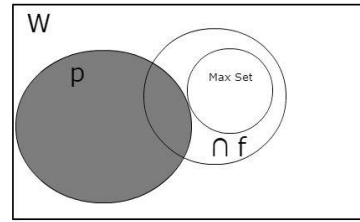
(a') *p* and ¬*p* are humanly possible   (b') *p* is humanly necessary and ¬*p*   (c') *p* is slightly possible and ¬*p* is
                                                         is slightly possible   humanly necessary

First, note that *p* and ¬*p* are both contextually possible in the sense of (a) in all three figures. Meanwhile, *p* is only humanly possible in (a') and (b'). In (c'), *p* is a "slight possibility[11]"; slight possibilities are still contextually possible because they are compatible with $\cap f$.

Now recall that to make an assertion which is in line with Grice's CP, Speaker must believe he is contributing new information to the common ground. If, as above and in most cases, the contextual possibility of *p* is already common ground, absent a specific discourse direction where Hearer is seeking a reaffirmation of contextual possibility, Speaker cannot make a felicitous assertion while expressing contextual possibility without changing some part of our theory. To repeat A) and B), we must either suppose a specialized pragmatic role for possibility modals, change their semantic denotation, or do both.   We shall adopt human modality, changing their semantics.

Recall that in response to (7) and (8), Hearer got a feeling that Speaker had a reason for predicting that (4) and (5) were true, and this feeling could lead to Hearer accepting (4) and (5) as more likely than they were before Speaker's assertion. In this way, intuition and the principled demand by CP for new information seem to converge. As we will see below, if we adopt human modality semantics for *may*, our semantics will show how new information can be gained from (7) and (8), and the last piece in our puzzle will fit into place.

If Speaker's utterance is interpreted as a proposal for *p* to be updated from a contextual possibility to a human possibility (i.e. from (a) in Figure 1 to (a') in Figure 2) the CP demand that the utterance contribute new information and the intuitive feeling that we do indeed obtain new information can be upheld. In a possible worlds framework, we

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[11] In Kratzer's later 1991 manuscript, she switches her definition of slight possibility, making it compatible with human possibility. Although she doesn't make her motivation clear or even mention that she changed it, it may have been due to her growing focus on graded modality, considering that the 1991 "slight possibility" could be related to "good possibility" on a single gradient. This dissertation is not principally interested in graded modality and so will be using the 1981 definitions.

might say utterance of (7) and (8) give Hearer the impression that Speaker has reason to believe that there are accessible worlds where (4) and (5) are true in the max set.

Furthermore, we can explain the internal change in the stance of Hearer. In the case of (4), if Hearer started out at (c') in Figure 2, Speaker's utterance could be understood as a proposal to adopt (a') instead. This would require Hearer to somehow modify her max set[12]. In the case of (5), Hearer may have started with (a) or (a'), but in either case if she believes that Speaker believes her stance (or the stance of the common ground in the case of multiple Hearers) to be (a), his utterance is felicitous according to the CP. In this case, acceptance of Speaker's assertion by Hearer may amount to her refining her stance from (a) to (a') or it may amount to her expressing her agreement without a change in her stance regarding p.

We can also explain the inappropriateness of (9). In order for Speaker to know that p is a human possibility, he must have a reason to believe that there is a p-world in the max set. Since Hearer does not believe that Speaker has specific knowledge about the weather in South Africa, she doesn't believe that he knows that p is a human possibility. If Speaker is not asserting human possibility, his assertion does not contribute new information, only reaffirming (a), and it violates CP. As CP predicts, (9) is an infelicitous utterance.

In this way, we can very roughly account for the observations above. However, there are many obstacles to overcome before this approach can be shown to be theoretically viable. Most importantly, since we have thus far described possibility as indicating a lack of knowledge, all Hearer will know from an assertion that p is a human possibility is that Speaker does not know anything which proves that p is not humanly possible. Since Hearer cannot know the full contents of Speaker's knowledge, how could she know if Speaker's assertion of human possibility requires her to update her current stance? It is possible that he knows even less than she. Furthermore, since Speaker does not know the contents of Hearer's knowledge, how could he believe that his assertion will update her stance?

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[12] A more accurate account of this change will be given in 2.2.3-4 where the ordering function is explained. More precisely, Hearer would add to her modal base in such a way that at least some accessible worlds she currently counts as members of the max set become inaccessible. This means that a new subset of accessible worlds is promoted to the max set, which now includes worlds where p is true.

The next section is an outline of how the CP requirements that Speaker assert only what he believes to be true and that will update the common ground ensure that, at least for a felicitous asserted modal proposition, Speaker has positive knowledge that the prejacent is humanly possible. This positive knowledge takes the form of a truth-conditional link between the prejacent and minimally one proposition in each of the MB and the OS.

1.4 Human possibility as an objective proposal

Unlike contextual possibility, which only entails Speaker's lack of knowledge, there is an "objective" form of human possibility which entails Speaker's possession of knowledge. Here, we shall define "objective" in terms of the action performed by the assertion and not to the "reliability" or the "intersubjectivity" of the relevant knowledge. An objective human possibility utterance is one which aims to change the possibility relation of its embedded proposition with respect to the common ground[13]. This characteristic makes it possible for Speaker to make assertions which are more typical in that they offer a clear way to update the common ground in terms of first-order belief[14]. In this section, we will compare contextual and human possibility and show how human possibility's semantics allows it to be known in an objective sense. We will conclude that this is why and how possibility assertions are informative.

Contextual possibility is a negative relation between Speaker's knowledge and the prejacent: p is contextually possible if Speaker doesn't know that p is false. The set of accessible worlds is the set of worlds left over after we have eliminated the possible worlds which are incompatible with our knowledge. Thus, as long as the modal base does not contain a proposition which contradicts p, p is possible. In following, if *may p* expressed contextual possibility, Speaker would not be required to have any knowledge concerning the prejacent to utter the proposition truthfully.

From Hearer's point of view, if this utterance led her to know that p is contextually possible relative to

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[13] This manner of using "objective" can also be seen in (P Arnaud & Hacquard, 2008; Pranav Arnaud, Hacquard, Crnič, & Sauerland, 2014) where they use "objective" to differentiate attitude verbs of "proffering" which semantically propose a proposition's addition to the common ground such as "claim" and "argue," from doxastic attitude verbs like "believe."

[14] It is already accepted that human possibility assertions must minimally add to the common ground something like "Speaker believes that p is a (human) possibility relative to his knowledge." Since this does not entail that the other discourse participants change their private beliefs regards to p, it is a second-order change.

Speaker's knowledge, the only information she could gain would be that he does not know anything which contradicts the prejacent. Additionally, if it turns out that *p* is contextually possible for herself as well, there is still no guarantee that the proposition is not impossible for a third party with more or different knowledge. Put in another way, even if it is decided that Speaker doesn't know that *p* is false in every accessible world, there will still be an infinite number of ways Speaker's knowledge may be and still be compatible with what Hearer knows about it. There could be Hearer-accessible worlds where Speaker has/lacks all the same relevant knowledge as her, accessible worlds where he has a great deal more relevant knowledge than her, and accessible worlds where he has much less. Given this, in cases that Hearer also didn't know that *p* was false, it would be unusual for Hearer to gain sufficient information from an assertion of *may p* for it be a useful contribution to a goal, as is required by Grice's quantity maxim.[15] However, if we look <u>within</u> contextual possibility, there is a distinction which can be made.

There is a form of human possibility that can be differentiated from slight possibility in the common ground, so long as no one knows whether *p* is true or false. Human possibility is defined with respect to the max set: *p* is humanly possible if there is at least one *p*-world in the max set. Like contextual possibility, *p* cannot be incompatible with Speaker's knowledge if it is humanly possible for Speaker. But for a *p*-world to be included in the max set, it is also necessary for *p* to be at least as compatible with the set of stereotypical states of affairs as its complement. This does not require positive knowledge, but it does provide that positive knowledge, and not a lack of knowledge, will allow human possibility to be an "objective" proposal.

Consider what a stereotypical state of affairs would be for (5): "that Bob left already." Suppose that Bob has other plans. If Speaker knew this, he might consider it a stereotypical state of affairs if "Bob left to do his other plans." Note that "Bob having left to do his other plans" being a stereotypical state of affairs is dependent on the condition that "Bob has other plans." We can express this stereotypical state of affairs as a proposition.

(10) If Bob has plans which require him to leave at a certain time, then Bob leaves by that time to do them.

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[15] If, for example, Hearer believed that Speaker is the only individual or one of a limited number of individuals who might be able to rule out the prejacent, a contextual possibility utterance may be a useful contribution for her. However, empirically speaking, it is certainly not the case that possibility utterances only or even usually occur in such cases.

Given an OS with this proposition[16], Speaker's possession of knowledge can work positively to ensure that the prejacent is compatible with the max set. If the antecedent is known by Speaker, it is true in all accessible worlds, i.e. in all worlds compatible with everything Speaker knows. In this case, according to the truth conditions of conditional sentences, the only accessible worlds at which (10) is true are those where the consequent is true. We will assume that the "certain time" referred to in the antecedent has passed at the time of the utterance, and so the consequent entails, "Bob left the party already." This means that (5) is ranked higher according to the OS than its complement, and is thus a human possibility.

However, while positive knowledge is sufficient, it is not necessary to satisfy the truth conditions of human possibility. First, we shall assume that Speaker does not know that "Bob has plans." We will keep the OS proposition constant. After all, there is no reason to assume that (10) suddenly stops expressing a usual state of affairs based on changes in Speaker knowledge. The stereotypical OS is an infinitely long and largely static set of propositions. What does change based on Speaker knowledge is the kinds of accessible worlds at which (10) is true.

1. Suppose that Speaker does not know that "Bob has plans." This means there are accessible worlds where "Bob has other plans" and where "Bob does not have other plans."

2. This means that there are accessible worlds where "Bob does not have other plans and he does not leave to do them".

3. This means that there are accessible worlds where "Bob left the party already" and where "Bob did not leave the party already" that satisfy the truth conditions of (10). As such, keeping all other OS propositions equal, both (5) and its complement are ranked equally.

4. Both (5) and its complement are human possibilities according to Speaker's knowledge.

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[16] Stereotypical OS propositions can very generally be accurately expressed as conditionals. The "usualness" of a contextually possible proposition depends on the utterance circumstances (or whatever circumstances are being evaluated by the modal) meeting certain conditions. The antecedent can express those conditions. More on this in 2.2.1.

This shows that positive knowledge is not necessary for the <u>truth conditions</u> of a human possibility assertion to be met; a lack of knowledge is sufficient just like with contextual possibility. However, if Hearer interprets Speaker's assertion as entailing a lack of knowledge, it would be uninformative for the same reasons we saw for contextual possibility. There would be accessible worlds where Speaker does have positive knowledge and accessible worlds where he does not. This does not allow for a felicitous assertion if we are to maintain the quantity maxim.

Human possibility based on a lack of knowledge allows the possibility that an increase in knowledge could result in the prejacent becoming a slight possibility, i.e. a human impossibility that is nonetheless contextually possible. Now suppose there is a different usual state of affairs which gives conditions for the complement of (5) being usual[17]. We will assume (11) is such a state of affairs.

(11) If there is a girl Bob is interested in at the party, then Bob does not leave the party until it ends.

1. Assume Speaker discovers that "There is a girl that Bob is interested in at the party."

2. (11) is true at some accessible worlds where Bob has not left the party but not at any accessible worlds where he has.

3. Thus, those accessible worlds where Bob has not left the party are ranked higher.

4. Recall (10). In a ranking based only on (10), since Speaker does not know if Bob has plans, accessible worlds where Bob leaves and where he does not leave are ranked equally.

5. With the addition of (11), the knowledge that "There is a girl at the party that Bob is interested in." has restricted the set of accessible worlds such that accessible worlds where "There is a girl at the party that Bob is interested in, Bob does not have other plans, and Bob does not leave the party early" are ranked

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[17] There will almost always be some situation under which a given proposition is usual. In fact, there are probably unaccountably many different ways for any prejacent and its complement to be usual.

higher than worlds where "There is a girl at the party that Bob is interested in, Bob does/does not have other plans, and Bob leaves the party early."

6. This means that there are accessible worlds where the complement of (5) is true that are ranked higher than any accessible world where (5) is true.

7. Therefore, (5) is a slight possibility and its complement is a human possibility.

In this case, Speaker has positive knowledge indicating that the complement of (5) is a human possibility. This positive knowledge resulted in (5) being a slight possibility, rendering the claim that it was a human possibility based on a lack of knowledge invalid regards Speaker's new state of knowledge. Now, if we can show that the complement of (5)'s status as a human possibility is not rendered invalid by positive evidence to the contrary (i.e. positive evidence that (5) is usual), we can say that positive knowledge ensures that the proposition which it supports is a human possibility and never a slight possibility.

Assume that Speaker comes to know that, in actuality, "Bob has plans". In such a case, since "There is a girl at the party that Bob is interested in" and "Bob has other plans" are both true in all accessible worlds, (10) would cause worlds where "Bob left the party already" to be ranked higher than those where "Bob did not leave the party already," and (11) would do the very opposite. This is a contradiction, and should result in the max set being empty.

As it turns out, this is one of the problems Kratzer's ordering semantics (i.e. human modality semantics) was designed to resolve, though it was originally targeted at deontic modality. The ordering function in human possibility is partial in such a way that contradictions such as these result not in an empty set, but in multiple orders. The technical explanation will relegated to section 2.2.4. For now, it is sufficient to understand that in the case from the preceding paragraph, accessible worlds where Bob left early would be highest ranked according to one order, and accessible worlds where Bob did not leave early would be highest ranked according to another. The max set takes the highest ranked worlds from all orders, and so in this case both (5) and its complement are human possibilities. That is, there is at least one highest ranked world in which (5) is true and one in which it is false, i.e. its complement is true We can thus conclude that once we have positive knowledge that a proposition is a human

possibility, it will never be a slight possibility.

Of course, it is possible for a human possibility to turn out to be contextually impossible, entailing falsity; it may also turn out to be contextually necessary, entailing truth. We will assume that human possibility assertions are made under the assumption that no discourse participant can rule out or confirm the prejacent. That is, when "true or false" cannot be determined for a given proposition, the next best thing is to determine whether it is a human possibility or not. Under this assumption, Speaker can make an objective proposal for the common ground. Since Hearer also knows the semantics of human possibility, she will know that Speaker is assuming that it cannot be determined whether the prejacent is true or false at the current time by the current discourse participants. She can then correct him if, in fact, she can rule out/confirm the prejacent, or otherwise evaluate whether to accept his objective proposal of human possibility as she would any other assertion.

If Speaker's assertion is interpreted as an objective proposal, Hearer will know that Speaker has positive evidence for the prejacent. Since Hearer may not know the precise identity of the positive evidence, but she will know that he wants her to update the common ground in such a way that there is some type of positive evidence for the truth of the prejacent. On the other hand, if Speaker's assertion is interpreted as human possibility based on a lack of knowledge, Hearer will have no idea what knowledge he does and does not have, parallel to a contextual possibility.

If we apply the quantity maxim requiring Speaker to believe his assertion will update the common ground, an assertion based on a lack of knowledge would be infelicitous. Thus, Hearer concludes that Speaker's knowledge includes positive evidence, because this ensure that it will entail an update to the status of the prejacent for Hearer assuming she only believes that the proposition is contextually possible. Since a modal base representing a lack of knowledge does not require an update, Hearer will not evaluate the 'quality' (truth) of Speaker's assertion based on one. That is, she evaluates the proposition which represents positive evidence for the prejacent and the 'quality' of a lack-of-knowledge modal proposition is irrelevant. Since Hearer and Speaker both know that this is so, Speaker can assume his assertion will prompt Hearer to modify her beliefs and Hearer will know that Speaker expects her to.

1.5 Interpreting the quality maxim of the CP relative to modal assertions

Grice proposed the maxim of quality as a central measure for keeping in line with the cooperative principle. For linguistic interactions, the quality maxim has been generally associated with semantic truth conditions. However, he intended his maxims as guidelines for rational behavior in general. For instance, he gives the following example for the quality maxim: "If I need sugar as an ingredient in the cake you are assisting me to make, I do not expect you to hand me salt" (Grice, 1989, p. 28). Clearly, the concept of "quality" that Grice had envisioned was not so simple as truth versus falsity. This is an instance of "Hearer" expecting "Speaker" to behave in such a way that he will make a genuine contribution to the goal of making a cake.

In the case of a non-modal assertion, Hearer can simply add its truth conditional content to the common ground if she deems it acceptable by her view of the world. However, in the case of possibility assertions, the truth conditional content varies according to what Speaker knows, and since Hearer cannot know what Speaker knows, his not knowing that the proposition is false, or that the proposition is not stereotypical, is not enough to tell Speaker how to update the common ground at a first-order level since she cannot know what the contents of his modal base are. We can summarize the problem as follows:

- If Speaker doesn't know that *p* is not a stereotypical human possibility, an assertion of *may p* is true, but it doesn't satisfy quantity.

- However, assuming an appropriate modal base (i.e. with positive evidence for *p*) will satisfy quantity, so Hearer concludes that Speaker must be assuming an appropriate MB.

- Hearer concludes that Speaker's utterance must be true with respect to that modal base.

Thus, quality has to be satisfied with respect to the assumptions needed to satisfy quantity. Given this cross-dependence, combining the two maxims as below will reflect our needs more precisely:

Make your contribution truthfully informative: Make your contribution such that it truthfully meets the current informativity requirements of the exchange.

As we have seen, semantic truth may be a necessary condition for a felicitous assertion, but it cannot be held as an independent requirement to be processed and fixed before applying the quantity maxim. If we fix the content of the modal base based on Speaker's knowledge, an assertion of *may p* will almost never be false and it will never entail a change in the common ground[18]. For example, in (7) and (8) we saw that the prejacent was already contextually possible, meaning that an assertion of *may p*, if its truth conditions were fixed independently of quantity, would just be stating that Speaker's knowledge entails something that is also entailed by the common ground. We also noted that they would be misleading if Speaker does not have a reason, or positive evidence, for predicting the prejacent.

If the quality maxim were "used up" by the lack-of-knowledge reading, we would have no choice but consign this to some alternative murky concept of "pragmatics". If "pragmatics" is interpreted as a combination of the common ground and the cooperative principle as applied to sentences, then my solution is thoroughly pragmatic. By interpreting the asserted proposition, in accordance with the quantity maxim, as intended as an objective proposal for the common ground, i.e. as a modal proposition whose modal base contains positive evidence, the truth conditions of the quantity-satisfying proposition must be met--the quality maxim is not "used up" by a quantity-defying interpretation of the proposition. In following, if Speaker does not have positive evidence, either he asserted a false proposition or he wasn't obeying the quantity maxim, and either one would be misleading.

(9) gives a prime example of what goes wrong when Speaker cannot satisfy both the truth and quantity maxims. Recall that we assumed that the common ground included that Speaker and Hearer do not have knowledge about South Africa's weather. Given this, Hearer believes that Speaker cannot supply a modal base with positive evidence for the prejacent and thus cannot be making an objective proposal. It would of course be true according

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[18] The common ground only includes common beliefs, so even if other discourse participants individually believe that *p* is impossible, as long as Speaker believes that *p* is possible it will be possible in the common ground.

to the lack-of-knowledge reading, but this would not satisfy the quantity maxim. Since this either violates the quantity maxim on the lack-of-knowledge reading or the quality maxim on the objective proposal reading, it is predicted to be infelicitous. As we observed, it is indeed intuitively infelicitous. Thus, (7), (8) and (9) corroborate that quality and quantity are not procedurally ordered, as seems to be tacitly assumed in interpreting epistemic modal assertions.

This may make it seem that we have to accept that an assertion of mere contextual possibility will never be felicitous. However, the key here is that the CP is not essentially tied to a linguistic (read: grammatical, as in section 1.1) construct, but to behavior. For linguistic interactions, this means that it is tied to the discourse process. Thus, if mere contextual possibility contributes to the common ground in the sense that discourse requires, then it should be possible to make a felicitous discourse move by asserting it even without positive evidence. For instance, when the question under discussion is whether or not the prejacent is false, knowing that Speaker does not know anything that contradicts the prejacent could satisfy the quantity maxim at that point in discourse[19].

What we can conclude is that it is often the case that the necessary and sufficient condition for a felicitous assertion of epistemic human possibility is knowing the truth of the antecedent of a stereotypical OS proposition whose consequent is truth-conditionally linked to the prejacent. This is because it is most often the case that the discourse minimally calls for an upgrade from contextual possibility. However, as felicity is determined by the discourse process which is, by definition, dynamic, the relation between linguistic constructs and felicity is not static.

1.6 Chapter summary

This concludes the general overview of the tripartite approach to interpreting modal utterances. I have shown that, by applying the quantity maxim, the semantics of human possibility, but not contextual possibility, makes it possible for Speaker to make an objective proposal for the common ground with a human possibility utterance despite the fact that the semantic truth conditions are relative to his private knowledge.

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[19] There is in fact an example of this situation in (DeRose, 1991), which will be taken up in 3.5.1.

The scope of Chapter 2 will be expanded to include *must*. It will be dedicated to giving a more complete explanation of the semantics of human modality operators and arguing for this semantics for epistemic modality in general. We will examine contradiction and entailment facts involving modals and observe that sentence-level relations among necessity and possibility operators do not give the complete picture of modal meaning. I will use this as evidence for the validity of human modality for epistemic modals, and propose a unified denotation for *may* and *must* differing only in force, which essentially follows Kratzer's original human modality denotations.

Following that, I will give a more explicit examination of the ordering source and the ordering function, after which I will propose some defining characteristics for the stereotypical conversational background, whose identity has been left to the imagination of each researcher in the past. This will prepare us for Chapter 3, where I will show how human modality semantics and Stalnaker's common ground framework can be reconciled without changing either by factoring in the Cooperative Principle.

Chapter 2 Epistemic human modality

Kratzer's "human modality" is not rigorously employed in the epistemic modality literature. Many representative works do adopt a Kratzerian modal base, but disregard the ordering source (Papafragou, 2006; von Fintel & Gillies, 2011) or implement it only selectively without making explicit under what conditions it is used or how/if it affects interpretation by Hearer[20] (Portner, 2009; Stephenson, 2007). On the other hand, even opponents of its adoption for epistemic modality (von Fintel & Gillies, 2010) have adopted it for circumstantial modality, which includes deontic, bouletic and teleological modality (von Fintel & Iatridou, 2005, 2008). The object of this chapter is to defend the validity of human modality relative to a stereotypical ordering source as the best semantic theory for epistemic modality.

From a theoretical point of view, since there is largely a consensus in the truth-conditional possible worlds literature that some form of ordering semantics has to be adopted for deontic modality (cf. Portner, 2009, p. 103), it can be argued that it is actually desirable that ordering semantics also be generally active in epistemic modality. A likely reason that it is not employed for epistemic modality now is a failure to notice that a human possibility statement can be interpreted as an objective proposal for updating the common ground. As I pointed out in Chapter 1, if human modality is not interpreted relative to a modal base with knowledge positively linked to the prejacent, it is nearly equivalent to contextual possibility from Hearer's point of view, and so there is little merit in implementing it in the analysis of epistemic modality. Thus, it may be that most researchers have just not seen how human modality would be helpful for analyzing epistemic modals.

To address this, I dedicate this chapter to fleshing out the three most active portions of human modality in allowing human possibility to systematically update the common ground.

1. One is its double relativity, which increases the set of worlds relative to which p and $\neg p$ are

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[20] Both Portner (2009) and Stephenson (2007) employ it in passing and for the same type of problem. When a Speaker admits his own possibility utterance is mistaken, he presents a theoretical puzzle for contextual possibility. Since contextual possibility is based on a lack of knowledge, it cannot be based on a mistaken belief. By assuming Speaker had a stereotypical ordering source in mind, it is possible for him to have had a mistaken idea. However, this is the result of an internal stance and does not suppose any role for the ordering source in interpretation by others.

distinguished from one to two. This is what allows human possibility and slight possibility to be differentiated.

2. One is the inherently vague nature of the stereotypical ordering source, which may be a large factor in the failure in the epistemic literature to see how epistemic human possibility can function as an objective proposal until now.

3. One is the partiality of the ordering function, which allows conflict resolution. This is essential for a stereotypical ordering source, since it is very often the case that both a proposition and its complement are in some way predictable/likely.

In the following sections, I will flesh out the raison d'être and assumptions of each of these ingredients and attempt to show how they fit with modality in general.

2.1 The double relativity of human modality

There is a vast space between knowing something to be true and knowing something to be false, and how we as rational beings understand that space plays a large role in shaping our decisions on how to interact with our surrounding world. Should we base a decision around p, or $\neg p$, or should we avoid any assumptions as to p at all? In our daily discourse events, a great deal of linguistic interaction is dedicated to determining whether propositions which we believe will have repercussions for any decisions we have to make are true or false. Often we have no choice but to rely on indeterminate evidence and settle for knowing only that a proposition is more/less or equally likely with respect to its complement. In the modal logic of linguistics, characterization of possibility and necessity are, generally and without committing to Kratzer or DeRose versions, attempts to formalize our linguistic expressions dedicated to this vast space by relating propositions to a characteristic set of worlds, such as epistemically accessible worlds, or to stereotypical, legal, or desirable worlds. Singly-relative possibility as we saw in DeRose's definition is one attempt to give such a characterization, and the double-relativity of Kratzer's human modality is another attempt.

As we saw in Chapter 1, the definitions of possibility and necessity do not affect only one proposition;

declaring that p is possible relative to a given set of worlds has implications for the entailment and compatibility relation of its complement ¬p relative to that set of worlds, and vice versa. The double-relativity of human modality adds an additional set of worlds relative to which p and ¬p are quantified, allowing greater variation and, thus, more ambiguity in the relations that a proposition and its complement can have simultaneously relative to one of these sets. Depending on how membership to these sets of worlds is determined, this can allow a more nuanced accounting of the space between known truth and falsity. For example, where with single relativity if a proposition is necessary its complement has to be impossible, with double relativity, a proposition can be humanly necessary while its complement is slightly possible. Defending the validity of double-relativity will require showing the need for this more nuanced accounting in our linguistic interactions.

In the case of possibility, doubly relative modality allows a stronger claim to be made because it narrows down the set of worlds with which the prejacent must be compatible. In the case of necessity, since doubly-relative modality narrows down the set of worlds from which the prejacent must follow, it results in a weaker claim than singly-relative modality.

In the first chapter I made a meaning-based argument and showed that double relativity is one way to better account for the intuitive meaning of possibility expressions. On the other end of the spectrum, support for human modality has come from observations by researchers that contextual necessity is often too strong for how *must* is used in discourse (Kartunnen, 1972). In fact, one of the motivations Kratzer (1981, 1991, 2012) had for proposing a (stereotypical) ordering source for epistemic modality was explaining the intuition that necessity assertions are intuitively somehow weaker than non-modal assertions.

However, there is a great deal of disagreement relative to how to interpret the intuitive strength and weakness of modal expressions. For example, von Fintel & Gillies (2010) assert that epistemic necessity operators like *must* are always "strong," meaning that they express a relation between a proposition and the entire set of an individual's epistemically accessible worlds, and that the "weakness" they are attributed is a confusion of "indirectness of evidence." Thus we end up with arguments from both ends of the spectrum. Given the variability in claims to the intuitive strength of these expressions, evidence based on linguistic fact rather than intuitive meaning seems

necessary.

In my explanation of (7)-(9), I only referred to the three configurations represented in Figure 2, repeated below for convenience. As it stands, I have not shown that there is a need to increase the overall number of available relations, only that there is a need to make more specific relations systematically available to Hearer. For instance, we might consider somehow keeping only the inner circle, the max set, in Figure 2[21]. That is, in explaining the role of modality in discourse, do we still need to maintain contextual necessity/possibility, or can we do away with these for more specific variants, such as human necessity/possibility (and thus do away with the distinction between slight possibility and contextual and human impossibility)?

The goal of this section is to show that the richer variation provided by double relativity is necessary not only to account for the relative strength of an utterance, but also to account for non-contradictory instances of *must -p* and *may p* in discourse, which seem to have gone unnoticed or at least unattended to in the literature. With this linguistic fact established, I will then show that human modality can account for all of the claims of strong and weak readings in the literature by allowing demands of the Cooperative Principle (CP) based on the state of the common ground to differentiate between an empty ordering source and a stereotypical one.

First, I will give definitions for the modal base and ordering source in line with human modality. Then I will show how they interact to allow 5 different possible belief states regarding a proposition and its prejacent to be distinguished. I will then show that all five of these are needed to account for entailment and contradiction facts, and will use this as evidence against the argument for a strong-necessity-only (i.e. singly-relative) modality. In conclusion, I will show how a single definition for necessity and possibility, that of human modality, can be used to express both strong necessity/ weak possibility (singly-relative modality) and weak necessity / strong possibility (doubly-relative modality) by allowing for an empty ordering source. Finally, I will make a concrete proposal for the denotations of *may* and *must*.

Figure 2 Human Possibility, Human Necessity, Slight Possibility

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[21] (Willer, 2013) does something formally similar to this in a dynamic framework.
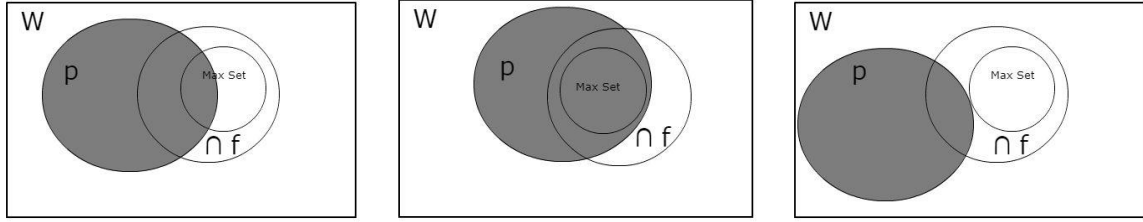
(a') *p* and ¬*p* are humanly possible   (b') *p* is humanly necessary and ¬*p*   (c') *p* is slightly possible and ¬*p* is
                                              is slightly possible   humanly necessary

2.1.1 The double-relativity of human modality

In human modality, the possibility of a given proposition *p* is defined in terms of its relation to two modal expression-specific contextually-dependent semantic variables. One represents the modal base, (MB) and the other represents the ordering source (OS). These semantic variables take "conversational backgrounds" as their values, which are functions from world-time pairs to sets of propositions (i.e. of type $\langle s, \langle st, t \rangle \rangle$). With only one conversational background, only impossibility, contextual possibility and contextual necessity can be defined, but with two conversational backgrounds, in addition to these three, we can also define slight possibility, human possibility and human necessity.

The propositions in an epistemic modal base are generally required to be "realistic," meaning that they must be pragmatically presupposed by a contextually-selected relevant individual to be true in the actual world. As I highlighted in Chapter 1, the modal base in epistemic modal utterances is assumed to take a conversational background composed of all the propositions which are known (to be true) by the contextually-relevant individual, who is very often Speaker. We shall assume the following definition.

Def. 1 Epistemic Modal Base

Let *i* be an index for a world-time pair in a context *c* which fixes a *c*-relevant individual *x* at *i*.

Let *f* be a contextual variable ranging over propositions.

Let *h* be a variable assignment function.

$[[f_{n,\text{epis}}]]^{c,i,h} = h(n)$ iff $h(n)$ is a set of propositions *S* such that for every *p* in *S*, *p* is known by the *c*-relevant

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individual *x* at i.

This definition assumes that there is an "epistemic" presupposition on *f* that the conversational background which is assigned to it is epistemic and relative to a *c*-relevant individual, and that this presupposition is the product of syntactic composition.[22] Importantly, the conversational background is sensitive to utterance time, and so each epistemic modal utterance will receive a potentially distinct conversational background. Consequently, the set of accessible worlds may also potentially be different for each utterance. As explained in Chapter 1, the accessible worlds are the set of worlds at which every proposition in the modal base is true, expressed as ∩*f*.

The ordering source is used to rank the accessible worlds determined by the modal base according to some kind of ideal represented by the set of propositions it contains. It is defined in essentially the same way as the modal base except that, unlike a modal base, its contents are not necessarily pragmatically presupposed by the *c*-relevant individual to be true in the evaluation world[23]. This is natural considering the intuitive role the ordering source is supposed to fill; an ideal is something to aim for, hope for, or expect, not something that is already known to be the case. As I explained in Chapter 1, I follow Kratzer in assuming that epistemic modal utterances are relative to a "stereotypical" conversational background, which is composed of the propositions which are believed by a contextually-relevant believer to be stereotypically true, i.e. to be a usual/normal/predictable/likely state of affairs/events.

Def. 2 Stereotypical Ordering Source

Let *i* be an index for a world-time pair in a context *c* which fixes a *c*-relevant individual *x* at *i*.

Let *g* be a contextual variable ranging over propositions.

Let *h* be a variable assignment function.

$[[g_{n,\text{stereo}}]]^{c,i,h} = h(n)$ iff h(n) is a set of propositions *S* s.t. for every *p* in *S*, *p* is believed to be a usual state of

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[22] I am not particularly invested in this assumption, but the epistemic requirement must come from somewhere and syntax seems like a reasonable assumption. Merging this framework with the event relativity of (Hacquard, 2010) would be a wise move and perhaps allow the epistemic (doxastic, in her framework) modal base to be derived from syntax and semantic composition rather than assumed, but I save that for a future endeavor.

[23] The diagrams of possibility configurations used in this dissertation show only the max set, which is a subset of the set of accessible worlds. This may cause confusion, but the propositions included in the OS are not necessarily subsets of the set of accessible worlds.

events by the *c*-relevant individual(s) *x* at i

As can be seen, this definition differs from that of the modal base only in terms of the presupposition on the conversational background variable *g*. Like the modal base, it is also sensitive to a contextually-relevant individual and the utterance time. As such, there may be differences as to which propositions are included in the conversational background depending on who the *c*-relevant individual is[24].

Now that we know roughly what the modal base and ordering source are, we can show what they do. Accessible worlds are determined by the modal base. Each of these is ranked, roughly, according to how many ordering source propositions are true at it in comparison with other accessible worlds. The max sets we saw in (a')-(c') in Figure 2 are the sets of accessible worlds which are not out-ranked with respect to their ordering source[25].

Now we have all the objects we need to give definitions for necessity and possibility in contextual and human modalities. I have also provided definitions of some essential logic vocabulary for the reader's convenience.

Logic Vocabulary

Def. 3 Propositional Truth (Relation between propositions and individual worlds)

Utterances of sentences express propositions. In a possible worlds semantics, a proposition is identified with the set of possible worlds in which it is true. Assuming our model gives us a set of worlds *W*, a proposition is a subset of *W*. A proposition *p* is said to be true at a world $w \in W$ iff $w \in p$. Otherwise, *p* is false at *w*.

Def. 4 Compatibility (Relation between propositions)

A proposition *p* is compatible with a set of worlds *X* iff there is at least one world $w \in X$ where *p* is true.

Def. 5 Entailment (Relation between propositions)

A proposition *p* is entailed by a set of worlds *X* iff *p* is true in every world $w \in X$.

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[24] What is considered a usual state of affairs for one individual may not be considered such by another. As we saw briefly in Chapter 1, the information Hearer obtains from epistemic assertions is very general, and thus the specific contents of Speaker's ideals will often not play a significant role in how a discourse event unfolds, so this relativity is only occasionally significant.

[25] A formal definition and in-depth explanation of the ordering function will be provided in its own section, but for now the object is to verify that we do indeed require doubly-relative semantics for discourse, so we need only understand that it produces a subset of stereotypical worlds inside the set of accessible worlds.

Def. 6 Contradiction (Relation between propositions)

A proposition p is contradicted by a set of worlds X iff p is false in every world $w \in X$.

The second set of definitions below lay out the full range of types of possibility which are provided for by a doubly-relative definition of modality. The contextual modalities are the same as before, but the addition of the max set in Def. 10 adds the new, human types of modality.

Modality Definitions

Def. 7 Contextual Impossibility

A proposition p is contextually impossible in w with respect to a modal base f iff p is contradicted by $\cap f$

Def. 8 Contextual Possibility

A proposition p is contextually possible in w with respect to modal base f iff p is compatible with $\cap f$

Def. 9 Contextual Necessity

A proposition p is contextually necessary in w with respect to modal base f iff p is entailed by $\cap f$

Def. 10 Max Set

For any set of accessible worlds $\cap f$ and ordering source g, the **max set** shall refer to $max_g(\cap f)^{26}$, the set of accessible worlds which are not out-ranked w.r.t. the ordering source.

Def. 11 Human Possibility

A proposition p is humanly possible in w with respect to modal base f and an ordering source g iff $\neg p$ is not entailed by $max_g(\cap f)$ (i.e. the max set).

Def. 12 Human Necessity

A proposition p is humanly necessary in w with respect to modal base f and an ordering source g iff p is entailed by $max_g(\cap f)$ (i.e. the max set).

Def. 13 Slight possibility

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[26] This will be formally defined in 2.2.3.

A proposition p is slightly possible in w with respect to modal base f and an ordering source g iff

(i) p is compatible with $\cap f$ (i.e. p is a contextual possibility);

-And-

(ii) $\neg p$ is humanly necessary in w with respect to $max_g(\cap f)$ (i.e. the max set)

Since a max set is a subset of a set of accessible worlds, it of course presupposes the existence of a set of accessible worlds. Since both sets must exist for human modality to exist, if we adopt human modality semantics we are free to assume definitions which are relative to only the larger set (contextual impossibility/possibility/necessity), only the smaller set (human necessity/possibility) or both (slight possibility). Note that slight possibility is the only definition which makes direct reference to both sets[27]. Although it has been largely overlooked in the literature and even by its creator, we will see that slight possibility plays a large role in the communication of belief states regarding given propositions in discourse.

2.1.2 Possibility configurations

In this section, we will highlight what is needed in order to corroborate there being a need for double-relativity. For our purposes, a *must* which we have determined denotes contextual necessity will be marked as $must_c$ and one which we have determined to denote human necessity as $must_h$. The same applies to may_c and may_h. We can only know which is intended by making deductions based on Speaker's utterances in a discourse event. The basis for these deductions is the logical restriction on the possibility status a proposition and its complement can each have it once.

A proposition p and its complement $\neg p$ are co-restrained in terms of what their relation can be relative to a given set of worlds: p and $\neg p$ can never both be necessary or impossible with respect to a single set of worlds. For singly-relative modality, this relation allows us to derive 3 consistent singly-relative belief states, each corresponding to one of the rows in Table 1 below.

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[27] Or more precisely, that needs to make reference to two distinct sets. We will see later that the max set and the set of accessible worlds can be equivalent, and in this case slight possibility cannot exist.

Must$_c$ ¬p tells us that ¬p is contextually necessary, and so by definition that there is no *p*-world in the set of accessible worlds. In order to felicitously utter *Must$_c$ ¬p*, Speaker's belief state must correspond to Row 1; Speaker must take p to be contextually impossible and ¬p to be both contextually possible and contextually necessary. The reverse also holds, so that *must$_c$ p* tells us that Speaker's belief state corresponds to Row 2. Put briefly, *Must$_c$* gives rise to a single possibility configuration regarding the proposition it operates over (i.e. the prejacent).

Unlike contextual necessity, contextual possibility is consistent with multiple possibility configurations. *May$_c$* *p* tells us that *p* is contextually possible. Since contextual possibility requires there to be at least one *p*-world in the set of accessible worlds, by definition ¬p cannot be necessary, eliminating Row 1. However, Speaker's belief state may correspond to either Row 2 or 3. Row 3 corresponds to the option where both *p* and ¬p are contextually possible. Thus, we end up with three possible belief states or possibility configurations regarding a given proposition.

Table 1 Possibility configurations for singly relative modality

	Contextually Impossible	**Contextually Possible**	**Contextually Necessary**
	must$_c$ not	may$_c$	must$_c$
1	p	¬p	¬p
2	¬p	p	p
3		¬p , p	

The following definition is intended to be general enough to use for both singly and doubly-relative modality. The portions related to doubly-relative modality will be explained below.

Def.   14 Possibility Configuration

For any proposition *p*, **the possibility configuration** of *p* shall refer to the status of *p* and ¬p regarding

whether each is compatible with or entailed by $max_g(\cap f)$ (i.e. the max set) and/or $\cap f$ (i.e. the set of accessible worlds).

Double relativity increases the number of possible possibility configurations for any given proposition. When we add a subset of the set of accessible worlds to the semantics of modality and thus make it doubly-relative, we essentially leave Row 1 and 2 the same but split Row 3 into three. This is reflected in Table 2 below, which shows the full range of possibility configurations allowed by double-relativity. Each row, 1-5, can be taken to represent a maximal belief state regarding a proposition to which a doubly-relative modal can make reference by virtue of its semantics[28]. The English word *may* is taken to be ambiguous between contextual possibility may_c and human possibility may_h.

Table 2 The possibility configurations of doubly-relative modality

	Contextually Impossible	Contextually Possible	Slightly Possible	Humanly Possible	Humanly Necessary	Contextually Necessary
	$must_c$ not	may_c		may_h	$must_h$	$must_c$
1	p	¬p		¬p	¬p	¬p
2	¬p	p		p	p	p
3		¬p , p	¬p	p	p	
4		¬p , p	p	¬p	¬p	
5		¬p , p		¬p , p		

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[28] A given individual will often not have a fully-fleshed out belief state. This corresponds to Row 3 in Table 1, or to undecided between 3,4 and 5 in Table 2. This will be important for the informativity of modal assertions. Of course, it is also possible for a given individual's belief state to be more fine-grained than either singly- or doubly-relative modality conveys. We are not interested in a precise characterization of internal belief states, only the portion of them that an individual can systematically express using modal forms. In the final chapter, deciding on a possibility configuration for the common ground will be proposed as how to "settle an issue/QUD" brought up by a modal assertion, similar to how a polar question is "settled" by deciding whether a proposition should be true, false, or undecided in the common ground (cf. Farkas & Bruce, 2009).

As above, *must* and *may* serve to partially indicate which belief state Speaker has. However, the increase in configurations also results in less determinative power for the linguistic expressions *must* and *may*. With respect to Table 1, *may* was ambiguous but *must* was determinative. With respect to Table 2, even *must* is ambiguous.

- Given a single instance of *must p*, we can determine that Speaker's beliefs correspond to either Configuration 2 or 3: 2 for contextual *must* and either 2 or 3 for human *must*.

- To determine which, we need more information. One way is to see if *may* is useable.

- In the case of Configuration 2, *p* is (both a human and) a contextual necessity, so ¬*p* is a contextual impossibility.

  ➢ If this is the configuration corresponding to Speaker's beliefs, Speaker should not be able to use *must p* and *may* ¬*p* without contradicting himself or changing his mind.

- In the case of Configuration 3, *p* is a human necessity but not a contextual necessity.

  ➢ ¬*p* is a contextual possibility but not a human possibility, that is, it is a slight possibility[29].

  ➢ If this is the configuration corresponding to Speaker's beliefs, Speaker should be able to assert *must p* intended as human necessity and a *may* ¬*p* intended as contextual possibility without contradicting himself.

- Therefore, if Speaker can assert *must p* and *may* ¬*p* without contradicting himself, his belief state corresponds to Configuration 3. If he cannot, it corresponds to Configuration 2.

This setup allows us a very simple way to verify that double relativity is necessary. According to singly-relative modality, a *must p* assertion is determinative and should never be compatible with a *may* ¬*p* assertion. In following, if we can find an instance where a single utterer can assert *must p* and *may* ¬*p* (or the reverse: *must* ¬*p* and *may p*) without contradicting himself, we need the ambiguity offered by double relativity.

Thus, we want to show that Prediction 1 can be wrong while Prediction 2 is not.

Prediction 1 (singly-relative): *must p* contradicts ¬*p*

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[29] There is no linguistic expression dedicated to slight possibility, so it must be deduced through a combination of other operators.

Prediction 2 (doubly-relative): *must p* is compatible with *may ¬p*[30]

Both singly and doubly-relative modality allow Prediction 1, but only doubly-relative modality allows Prediction 2. If in discourse, Prediction 1 covers all of the entailment relations that we need, then we have to go elsewhere for evidence in favor of double-relativity. If, on the other hand, Prediction 2 is true, we will have found convincing evidence for the need for double-relativity which is based in linguistic fact rather than on a subjective sense of strength or weakness.

von Fintel & Gillies (2010) claim the following sentences support a single relativity definition for epistemic necessity.

(12) It must be raining, but #perhaps[31] it isn't raining.

(13) Perhaps it isn't raining, #but it must be.

(14) There is a vanishingly small chance that it isn't raining, #but it must be.

In reference to these examples, they point out that even though *perhaps ¬p* does not remove all ¬p worlds from the modal base, it is still contradictory to *must p*. Under the assumption that *perhaps ¬p* is weak (contextual), they posit this as evidence that *must* cannot be relative to a smaller set than the set of accessible worlds. However, if *perhaps ¬p* is taken to denote $may_h ¬p$, it says there is at least one ¬p world in the max set. If *must p* is taken to denote $must_h$, then it says there is no ¬p-world in the max set, so they contradict each other. The observations can thus be explained by Prediction 1 above, which as we saw is compatible with either single or double relativity. Thus, (12) and (13) do not offer evidence either way for our issue. As long as *must* and *perhaps* denote relativity to the same set of worlds, they contradict each other.

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[30] Note that we must show not just that $must_h p$ and $may_c ¬p$ are compatible, but that $must_h p$ and $may_h ¬p$ <u>are</u> incompatible. Otherwise the evidence would point not to double relativity but to a break in the duality of *may* and *must* such that there are conceptual differences other than force (possibility vs. necessity).

[31] In the examples they use *perhaps* instead of *may*, but they are proposing a general definition for possibility and necessity operators, so their predictions should be the same for *may*. One motivation for the choice of *perhaps* may be to control for the increased salience of *may* and *must* as a pair.

von Fintel and Gillies acknowledge this issue in a footnote, and claim to have ousted the possibility of double relativity definitively with (14). Since *a vanishingly small chance that ¬p* would certainly reflect weak (*may$_c$*) possibility even if we assumed that *perhaps* denotes strong possibilty (*may$_h$*), and it is still contradictory with *must p*, they conclude that *must* is strong and, worded in terms of our current investigation, singly-relative. However, what this may reflect is some sort of clausal restriction on the type of modality such that when there are multiple epistemic modals in a given clausal unit one cannot denote singly-relative while the other denotes doubly-relative modality. I offer the following as evidence that that is exactly the case.

(15) John: Where's Bob?

  Taro: He may have gone to the store.

  Jane: No, look. His brief case is gone. He must have gone to the office.

  John: So you're sure he didn't go to the store?

  Jane: Well, no. He *may* (marked intonation) have, but come on! He must have gone to the office.

If we only allow strong necessity, we must assume that Jane, rejecting Taro's suggestion, believes that "Bob went to the store" is contextually impossible. However, if this were the case she would be contradicting herself in her next utterance, where she would have to be agreeing with Taro. However, we can see that she still upholds her original opinion, so she seems to believe her belief state is consistent.

One way for it to be consistent would be to say that "Bob went to the store" and "Bob went to the office" are not mutually exclusive, but if this were the basis for Jane's utterance then we would predict Jane does not disagree with Taro's *may*, which goes against her utterance of "no". Furthermore, the answer being sought is why Bob is not present, not what his trajectory is, so any proposition offered as an answer should be a competitor entailing the complement of the other competitors.

We can give an adequate explanation if we assume doubly-relative modality. First, we can say that Jane takes Taro's *may* to denote *may$_h$.* Then, in her first utterance, "Bob went to the office" is presented as humanly necessary relative to a

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stereotypical ordering source and "Bob did not go to the office" as only contextually possible. This disagrees with Taro's *may* given that Taro presents *Bob went to the store* as a human possibility. Finally, in her second utterance, *Bob went to the office* is presented as a contextual, not a human, possibility employing may_c. $May_c\,p$ does not contradict $must_h$ $\neg p$, so Jane's second utterance need not contradict her first. Also note that Jane's *may* seems to require marked intonation, suggesting that she intends it to be interpreted differently from the standard interpretation, or perhaps from the interpretation it is given in Taro's utterance[32]. We might assume the difference is that *may* in Jane's final utterance is presented as may_c. Since for $must_h$ $\neg p$ and $may_c\,p$ to be consistent, p must be a slight possibility, we can infer that Jane's belief state corresponds with Configuration 4 in Table 2[33]. Thus, we have seen that Prediction 1 from above can be false, and that Prediction 2 correct, showing the need for double relativity in the semantics of English modal assertions.

Now consider the following utterance.

(16) John *may* have won, but I doubt it.

Note that this *may* also prefers marked intonation or the sentence sounds contradictory. As in (15), marked intonation on *may* may indicate that it denotes may_c. Given this, the need for marked intonation suggests that *doubt* cannot pair with may_h. Since a proposition that is slightly possible cannot be humanly possible, this suggests that *doubt* is a marker of slight possibility. Also note that in interpreting this utterance, our attention goes to what Speaker's reason for doubting John's victory might be while the possibility of John winning seems like a grudging concession that cannot be ruled out rather than a possibility that Speaker endorses. Taking *John won* to be *p*, Speaker's belief state would correspond to Configuration 4. Again we have evidence for *may* being used to differentiate between slight and human possibility in discourse, and thus corroboration for double relativity.

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[32] The need for marked intonation seems to be idiosyncratic to English. The same discourse event did not require marked intonation on *may* (*kamo shirenai*) in Japanese.

[33] In the discussion of pragmatics in a later chapter, I shall propose and demonstrate that discussion involving modals often involves clarifying and bringing change to the belief state of each discourse participant relative to the five configurations.

2.1.3 Weak and strong *must*

Above we saw instances where *may p* served to denote that *p* is a human possibility and where it served to

denote that *p* is a contextual possibility (but not a human one). However, we have only seen cases where *must p*

denoted that *p* is a human necessity. In this section, we will conclude that *must* also has a contextual necessity reading

available, but that it is usually not the salient reading.

(17) It's raining.

(18) It must be raining.

The problem is that (18), if interpreted as a contextual necessity assertion, is theoretically stronger than (17),

but is intuitively weaker. (17) only requires that Speaker believe it is actually raining. (18), taken as a claim of

contextual necessity, would mean that Speaker believes not only that it is raining, but that given his current

knowledge of the state of the world, there is no other possibility than rain.

This may at first seem to also be the case for (17), and if it happens that Speaker utters (17) in response to

physically seeing that it is raining, there would be no other possibility than that it is raining. However, Speaker will

sometimes assert (17) without such decisive evidence. For instance, if he is indoors and sees that all the people

around him have wet umbrellas, he may assert (17). In this case, Speaker only claims that he believes it is raining

and, through conversational principles, that he believes he has sufficient justification to assert that it is. However, he

does not make any claims about there being no other explanation for people with wet umbrellas. With (18) as

contextual necessity, the assertion would be that there are no other possible alternatives; if there are wet umbrellas,

the only thinkable possibility is that it is raining. Since (17) feels stronger than (18), this does not seem to be an

accurate portrayal of (18)'s meaning.[34]

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[34] Both a strong and a weak reading seem to be possible with some work. The strong reading seems easier to get if *must* is
pronounced with marked intonation.

Double-relativity addresses this problem by making necessity weaker by defining epistemic necessity relative to a stereotypical ordering source. (18) would only assert that the only stereotypical/predictable possibility is that it is raining. As Kratzer says, "There are worlds w such that among all the worlds which are compatible with what we know in w, those which come closest to the normal course of events in w don't include w itself" (Kratzer, 1991, p. 645). As a glance at (b') in Figure 2 from section 2.1 shows, in the case in which p is a human necessity, not all worlds in the set of accessible worlds need be p-worlds, only all the worlds in the max set. In following, (17) requires Speaker to believe the prejacent is true but (18) does not, and so, by the quantity and quality maxims, Speaker will use (17) rather than (18) when he is certain of the truth of the prejacent. This offers an explanation for why (18) would feel weaker than (17). This would also explain why it is odd to say (18) when Speaker does have direct evidence; (18) would be a weaker assertion than Speaker is capable of, and so it would violate the quantity-quality maxim.

But why do we interpret (17) in its human necessity reading instead of its contextual one? Doubly-relative semantics does not rule out that Speaker can ever use *must p* to denote contextual necessity. It can even be forced linguistically. For instance, the fact that "must" and "there's a vanishingly small chance" are contradictory in (14) show that must at least has a contextual necessity reading available.

I propose that in most cases, Hearer will assume a weak human reading simply due to the low probability of Speaker having strong enough evidence for a contextual one, but that she will not rule it out the strong one until Speaker makes it absolutely clear which he intends. In some cases she will continue the conversation on this assumption, and on others she will deem it necessary to confirm with Speaker. We saw an example of the latter in (15).

In (15), Jane asserted, "Bob must have gone to the office," but John was dubious that Jane could really know for sure and asked her to confirm, where she admitted she was not absolutely sure, indicating that the necessity she had asserted was human. The fact that Bob asked in the first place, and that this is a very natural way for a conversational to proceed, shows the inherent ambiguity of *must p* assertions between contextual and human necessity. The ambiguity of *must* assertions between contextual and human necessity can be a driving force in discourse, which we will see more of in 4.2.

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2.1.4 Denotations for *may* and *must* as human possibility/necessity operators

We have seen evidence that both *may* and *must* can express human modality and contextual modality in discourse. This means we must either assume a separate definition for contextual and human *may* and *must* and attribute the fact that they both rely on a set of Speaker-centered epistemically accessible worlds as coincidence, or find some way for a single definition to cover both cases. Kratzer's original proposal has already provided one, though her motivation was based on the fact that graded modality is present for both circumstantial and epistemic modals. She says, "... a better view would be to assume that the interpretation of modals in general depends on an ordering source as well as a modal base where either parameter may be filled by the empty conversational background" (Kratzer, 1981, p. 50). I concur, adding to her justification the fact that both contextual and human modality are expressible by epistemic *may* and *must*.

If the ordering source is the empty set[35], then the max set is equivalent to the set of accessible worlds. Recall that the max set is the set of accessible worlds which are not outranked according to the ordering source. A world w is outranked by another world w' if w' satisfies the truth conditions of all the OS propositions that w does, and at least one more. Since there are no propositions in the empty ordering source, there is no way for one world to be ranked higher than the other. Thus, all accessible worlds are ranked equally. If all accessible worlds are ranked equally, the max set will include every accessible world. This makes the max set is equivalent to the set of accessible worlds. In following, in the case of the empty ordering source, contextual possibility is logically equivalent to human possibility, and slight possibility does not exist. Thus, we can give *may* and *must* each a single definition, and allow context to differentiate between whether they take the empty ordering source or a stereotypical one.

Preliminary Definitions (repeated)

Let i be an index for a world-time pair in a context c which fixes a c-relevant individual x at i.

Let f be a contextual variable ranging over propositions which can function as a modal base

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[35] We would get the same results if the OS contains at most a subset of the propositions in MB.

Let g be a contextual variable ranging over propositions which can function as an ordering source.

Then

$[[f_{n,epis}]]^{c,i,h} = h(n)$ iff h(n) is a set of propositions S s.t. for every p in S, p is known by x at i[36].

$[[g_{n,stereo}]]^{c,i,h} = h(n)$ iff h(n) is a set of propositions S s.t. for every p in S, p is believed to be a stereotypical state of events by x at i.

$[[\text{MAX}]] = \lambda g.\lambda f. \max_g(\cap f)$

Def. 15 Stereotypical Max Set

$[[\ [\ f_{8\_epis}[\text{MAX}\ [\ g_{9\_stereo}\ ]\ ]\ ]\ ]]^{c,i,h} = \max_{h(9)}(\cap h(8))$ (abbreviated below as $\max_g(\cap f)$)

Def. 16 Epistemic *may/might*

$[[\ [\ [\text{might/may}\ [\ f_{8\_epis}[\text{MAX}\ [\ g_{9\_stereo}\ ]\ ]\ ]\ ]\ p]\ ]]^{c,i,h} = 1$ iff $\exists w':w'\in p\ \&\ w'\in \max_g(\cap f)$

Def. 17 Epistemic *must*

$[[\ [\ [\text{must}\ [\ f_{8\_epis}[\text{MAX}\ [\ g_{9\_stereo}\ ]\ ]\ ]\ ]\ p]\ ]]^{c,i,h} = 1$ iff for all w': $w'\in \max_g(\cap f) \rightarrow w'\in p$

These denotations are in no way ground-breaking; in fact they are almost exactly identical to Kratzer's denotations, except for the following points:

1. In addition to an evaluation world, they encode an evaluation time into the denotation.

2. Conversational backgrounds are not set by interpretation parameters. Instead, an assignment function h assigns conversational backgrounds to semantic variables with syntactically-obtained domain restrictions.

3. They concatenate the modal base and ordering source into a max operator, yielding a single proposition rather than a set of propositions. The max operator allows modal auxiliaries to be formalized as standard quantifiers. Note that this is a proposal for the syntax of possibility and necessity operators and does not preclude incorporating an ordering function directly into the truth conditions of other intensional operators.

4. The source of both the modal base and the ordering source is the beliefs and knowledge of a contextually-

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[36] Note that the epistemic presupposition that "p is known by x" is universal, and so is vacuously true for the empty set. Therefore, there is no need to define an empty conversational background syntactically as it satisfies the presuppositions. If the assignment function assigns the empty ordering source to g or f, it will satisfy the presupposition.

determined individual.

2.1.5 Section Summary

In this section, we saw how double-relativity allows the theoretical concepts of possibility and necessity to be defined relative to a more specific set of worlds than single relativity while also preserving the capability of referring to a more generally-characterized set of worlds. We saw how this allows a more fine-grained representation of belief states, expressed by Configurations 1-5 in Table 2. We then saw that these configurations are all necessary to account for the use of *may* and *must* in discourse based on an absence of contradiction in a discourse event where single relativity would entail contradiction.

Having shown that both contextual and human modality are relevant to discourse, we then proposed human possibility and necessity as the only denotations for *may* and *must*. Rather than splitting contextual and human modality, they are both taken as deriving from a single semantic denotation where what we had been calling human modality is the result of a non-null ordering source (which is not entailed by the MB) and what we had been calling contextual modality is the result of a null ordering source.

In the next section, we will take a closer look at stereotypical ordering sources. In the case of deontic modality, researchers rely on the ordering source to provide clear truth conditions. However, this is not the only, or even the fundamental role of the ordering source. Making it explicit what the stereotypical ordering source does and does not have to do will be an important part of showing that human modality is the most suitable denotation for epistemic modality expressions.

2.2 The motivations for assuming a stereotypical ordering source

As I pointed out at the beginning of the chapter, most possible worlds semanticists actively employ human modality semantics for deontic modality, but tend to do so inconsistently for epistemic modality (cf. Papafragou, 2006; Portner, 2009; Stephenson, 2007). As we saw in the last chapter, some specifically argue against human modality for epistemic modals (von Fintel & Gillies, 2010) while employing it for circumstantial modals (von

Fintel & Iatridou, 2008). A reason for the difference in commitment to human modality between deontic and epistemic modality may be related to the inherent vagueness of stereotypical conversational backgrounds as compared to deontic conversational backgrounds. The vagueness of what counts as a stereotypical conversational backgrounds can make truth judgments difficult. This can lead researchers to disregard the ordering source for epistemic utterances.[37]

When an authority figure tells a man "Bob may vote," the authority figure will have made a false statement unless Bob is a legal citizen of at least 18 years of age. What would it take to make "it may rain" false? Would we say it because we saw the weather report? Because it's cloudy? Because our joints ache? Because it's especially humid? There are an unbounded number of reasons we could think of to suppose that "it rains" is a normal or predictable state of affairs given our knowledge about whatever situation we are predicting rain for. Since it is so difficult to pinpoint what characteristic(s) Speaker supposes are responsible for making "it rains" a stereotypical state of affairs, assigning a truth value can seem impossible, absent of contradicting the prejacent itself[38].

However, the difficulty of assigning a truth value based on such a set of propositions does not jeopardize its basic function as an ordering source: dividing contextual possibilities into human and slight possibilities. In section 2.1, we saw that epistemic modal assertions must be doubly-relative in order to explain why an individual could say *must ¬p* and *may p* without contradicting herself or changing her mind in (e.g. Jane in (15)). In Chapter 1, we saw that they influence Hearer's interpretation systematically, creating a sense of informativity. It is clear that the ordering source must have an important discourse role to play in epistemic modal utterances.

Since double relativity requires a second conversational background, epistemic modal utterances must have one. Furthermore, Kratzer has already shown that ordering semantics are necessary for deontic modals, so it is reasonable and theoretically desirable to assume that epistemic modals, which use the same forms as deontic modals in English and many other languages (cf. (Matthewson, 2017)), use the same denotation. Nevertheless, the fact remains that it is not clear what a stereotypical conversational background is. Our task in this section will be

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[37] The reasoning may be something like: if it doesn't give clear truth conditions, it can't play a significant role in interpretation; if it doesn't play a significant role in interpretation, it can't really be part of Speaker's intended meaning.

[38] Since *may/must* are relative to Speaker's knowledge, even this does not make their proposition false.

to make the stereotypical conversational background as explicit as possible and show that it does require use of ordering semantics.

2.2.1 A way of sorting contextual possibilities

In general, an ordering source (OS) contains propositions which represent some kind of ideal. A world where the propositions in an OS are true is higher-ranked by some standard represented by that OS than worlds where some or all of them are not. We want, or expect, the propositions in an OS to be true at our world, but we know that not all of them are.

The ability to sort contextual possibilities is the function we require of an ordering source. An epistemic modal base tells us what propositions are known to be true by some individual, and we derive from that set the set of all worlds which are compatible with it, what he have called the set of accessible worlds. The ordering source orders those accessible worlds based on how ideal they are according to some standard. This division of labor between the modal base and ordering source allows us to derive human (maximally ideal) and slight (not maximally ideal) possibilities.

With deontic modals it is self-evident that some kind of "legal" or "regulatory" ideals are involved. A deontic conversational background is a set of propositions that "represent the content of a body of laws or regulations" (Kratzer, 2012, p. 37). A proposition in a deontic conversational background sorts contextual possibilities in terms of legality and illegality. The maximally legal possibilities correspond to those propositions which are compatible with the max set based on a law- or rule-based deontic ordering source, identified as a conversational background.

Deontic conversational backgrounds tend to be finite lists provided by regulatory bodies such as governments, authority figures (teachers, parents), households, associations, etc. Typical laws and rules limit the behavior of individuals or the status of happenings of certain kinds, e.g. (i) people under 20 may not drink alcohol, (ii) only citizens may vote, (iii) only students who have finished their homework may participate in recess, (iv) smoking is prohibited on public property, etc. These laws in themselves only apply to certain individuals or situations. For instance, (i) tells us that it is illegal for people under 20 to drink. It does not tell us that 21 year olds

may drink alcohol, though we will usually assume that this is the case. In order to regulate society, laws pick some subclass to which they should apply.

In the case of a stereotypical ordering source, Kratzer describes the propositions as reflecting what is normal in the evaluation world according to "some suitable normalcy standard" in that world. Normalcy is not typically determined by explicit lists provided by regulatory bodies, and accordingly the exact nature of the propositions has been left (purposely) to the imagination,

"What is to count as normal? Definition (e) [i.e. the quoted portion above] is deliberately vague and non-committal about what suitable standards of normalcy are and where they may come from."

(Kratzer, 2012, p. 37)

There are many different standards one can use for determining that something is "normal," "usual," or "stereotypical." The standards will vary depending on who is evaluating whatever it is that is being evaluated. Even so, we can find some empirical necessities in order for a proposition to represent a stereotypical state of events, which turn out to be very similar to the characteristics we saw in a deontic conversational background.

When we deem something "stereotypical" or "normal" we do so because we perceive it to belong to some class of individuals, events, or states which we perceive to usually behave in or appear in a certain way. For example, the proposition, "that it rains," cannot indicate stereotypicalness without a subclass of states in which rain is supposed to occur, be it a subclass of time such as one of the months of the year, a subclass of environment such as a configuration of the sky, a subclass of personal experience such as when an individual goes to the beach. Likewise, the proposition, "that people eat 3 meals a day" can only tell us eating 3 meals a day is stereotypical if we qualify which people it is that are supposed to eat 3 meals a day, whether it be all people, healthy people, people of a certain culture, etc.

Thus, we can see that both deontic and stereotypical ordering sources pick out some subset of states or individuals and associate that subset with a proposition. For purposes of analysis, conditionals are an optimal way of accomplishing such situational qualification because they have well-studied logical characteristics. Throughout this

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dissertation, deontic and stereotypical ordering source propositions shall be expressed as conditionals, where the antecedent qualifies the situation and the consequent says what is legal/stereotypical of said situation[39]. Using conditionals in the ordering source will allow clear predictions for truth conditions and inter-propositional relations.

For example, the following propositions are probably contained in the stereotypical conversational background that many individuals would generate the following, where each value for x and t determines a separate ordering source proposition.

g ={ p_1| If it's thundering in x at t, it's raining in x at t ; p_2| If it's sunny in x at t, it's not raining in x at t}[40]

Stereotypical states of events are in essence generalizations which individuals draw from their experiences. Any given state of events is composed of an infinite number of characteristics, and any of those characteristics can be associated by an individual with some other characteristic. For individuals who count the above propositions as stereotypical states of affairs, most or at least many of their experiences with thunder will have coincided with rain, and most or at least many of their experiences with sunny weather will have coincided with no rain[41]. Thus, we get common associations like those in g above, but there may also be unfortunate individuals who consider "If I go to the beach at t, it rains at t," or "If my right knee hurts at t, it rains at t" a stereotypical state of affairs. There are countless more stereotypical states of affairs concerned with *raining* and *not raining* that could be included in g.

Returning to the problem of truth conditions, this multitude can make it difficult for Hearer or a researcher to pinpoint what states of affairs are relevant for a given modal utterance. In fact, it is often the case that Speaker himself does not have a clear idea of what he considers normal or why, even though he has an intuition that it is. This does not hamper the ability of an ordering source to sort contextual possibilities.

When Speaker says "It might rain," it is not necessarily important why he thinks that "it rains" is part of a

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[39] Some ordering sources, such as bouletic ones, are not dependent on external conditions. Though they will scarcely be mentioned in this dissertation, where they are they will not be expressed as conditionals.

[40] In this case the variable ranges over places and times, but there could also be variables for any type entity.

[41] Nowhere does this experience require that thunder and sun never coincide, so we get two generalizations which can collide in the actual state of events. When they don't collide, of course we'll choose the generalization that fits the situation, but when they do collide will typically be able to assess the situation based on different generalizations.

stereotypical state of affairs. Speaker may feel entitled to make the assertion because he sees someone with a wet umbrella, but Hearer may agree because she thinks the air is moist, having not even noticed the wet umbrella. On the other hand, she may disagree with him because she can see the cloudless blue sky out the window. In either case, Speaker's utterance has indicated that he believes that "it rains" is a stereotypical possibility[42]. For the stereotypical ordering source to sort contextual possibilities, Hearer need only recognize that Speaker's utterance is relative to a stereotypical ordering source. Hearer will have her own set of stereotypical states of affairs which she can use to evaluate his utterance.

Thus, maintaining flexibility as to who or what determines normalcy is an important consideration to avoid evaluating the truth of epistemic possibility/necessity utterances according to standards by which Speaker did not intend them to be evaluated. As researchers we are better off not generating an explicit list of propositions expressing stereotypical states of affairs. Instead, we can deduce them based on the utterance and its surrounding context, just as Hearer does. This does not hamper their ability to sort slight and human possibilities.

2.2.2 Normativity

As stated at the beginning of this section, OS propositions are not selected because they are believed to be true. Put another way, their inclusion in the domain of the ordering source variable g's domain is not dependent on truth. Instead, they are chosen because they serve as norms of some type, whether that norm be of legality or of stereotypicality. The reason these norms can serve to order worlds differentially is because they are not true in all accessible worlds, i.e. they are sometimes false.

Imagine a strong-handed country where the voting law is "All citizens must vote." Now suppose that John is a citizen. "John may vote" will be true, and so will "John must vote". But suppose he did not vote. Then there are no accessible worlds at which the propositions representing the law are all true. Now suppose that Taro, also a citizen, did vote. John's not voting results in a set of accessible worlds, and in none of them is it true that "All

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[42] Of course, there will also be instances where the exact reasoning is important, particularly when Hearer disagrees. Hearer will be able to disagree even if she does not know that the prejacent is false if she knows that Speaker considers the prejacent part of a normal state of affairs and that she does not.

citizens vote," so they could all be taken as "illegal" worlds. However, John's not voting does not result in Taro's voting suddenly being illegal. Taro has obeyed the law and John has not.

What we want in the OS is a proposition which can be judged as true or false for a given state of affairs and still be used for other states of affairs. Thus, the law that we know, "All citizens must vote," acts as a sort of counter ranging over individuals, and the propositions which are used for evaluation in the ordering source are, "if John is a citizen, John votes," "If Taro is a citizen, Taro votes," etc. That is, the propositions in the ordering source represent specific cases among the set of cases over which the law operates. A world where John and Taro both vote is legally better than one where only Taro votes, but a world where only Taro votes is legally better than a world where neither John nor Taro vote.

The same thing can be said for a stereotypical background. For a stereotypical quantifier, we will employ *usually*. I wish not to identify the stereotypical quantifier precisely as the English word *usually*, leaving room for our intuition of what a "stereotypical" state of affairs is[43], but will use the word for exposition throughout this dissertation.

Now, assume a stereotypical trend, *usually, if it's thundering it's raining*, and let us suppose that it is thundering in Sapporo and Tokyo. Let us also suppose that we know it is not raining in Sapporo. Intuitively, this does not mean that it is no longer true that "usually, if it's thundering, it is raining." Just as the law applied separately to distinct individuals in the deontic voting example considered above, the stereotypicality association between thunder and rain applies separately to distinct places and times, and the propositions which are actually evaluated in the ordering source are, "if it's thundering in Sapporo, it's raining in Sapporo," "if it's thundering in Tokyo, it's raining in Tokyo," etc., where the specific places and times have been substituted in. Worlds where it's raining in both Sapporo and Tokyo are the most stereotypical, but we know that it is not raining in Sapporo so the most stereotypical worlds we can expect are those where it is raining in Tokyo.

At this point, it will be helpful to make the relationship between stereotypical trends and ordering source

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[43] There may be cases where "normally" or "predictably" work better intuitively and there may be cases where no lexical adverb fits just right.

propositions more explicit. Lewis (1975) has called adverbial quantifiers like *usually* "unselective quantifiers," and suggested that they quantify over any free variables in a sentence; these variables could range over individuals, sets of individuals, events, or minimally only times, and those times could be instants or intervals (Lewis, 1975). We will follow Lewis and call each instantiation of a property embedded under a quantifying adverb a "case." Each case corresponds to a tuple of values for the free variables. Propositions for a stereotypical OS are specific cases that instantiate the property over which a "stereotypical" quantifier quantifies.

For any property extracted from a stereotypical trend there is an antecedent and a consequent; the antecedent, *a'(x)*, consists of restrictions on the domain of each free variable in *x*. Only values which are in the domain of *a'* will be included in the stereotypical association with *p'*. *x* shall refer to a tuple containing all and only the free variables in *a'(x)* (which by definition are equivalent to those in *p'(x))*. There is no hard rule for how many free variables there will be in any given such *a'(x)*. Table 3 below includes some examples taken from other places in the dissertation.

Table 3 Examples of stereotypical trends

	Stereotypical Trend	*x*	**if *a'(x), p'(x)***
a	Usually, if it's thundering in place *y* at *t*, it's raining at in *y* at *t*.	x= <*y, t*>	if it's thundering(x), it's raining(x)
b	Usually, if it's sunny at place *y* at time *t*, it's not raining at *y* at *t*.	x =<*y, t*>	if it's sunny(x), it's not raining(x)
c	Usually, if Bob has a girl he's interested in at place *y* during time interval *t*, he stays at *y* during *t*.	x= <*y, t*>	if Bob has a girl he's interested in(x), then he stays(x)
d	Usually, if Bob has plans at time *t* at place y and if Bob's current location *z* is not *y*, he leaves *z* for *y* before time *t* to do them.	x= < *t, y, z* >	If Bob has plans(x), he leaves to do them(x)

e	Usually, if a boy y likes a girl z, y will go the prom with z if z asks y.	x = <y, z>	If a boy likes a girl (x), he'll go to the prom with her (x) if she asks him.

In (a), we have "Usually, if it's thundering(x), it's raining(x)," where x would need to specify a place and time to make a proposition[44]. To derive an appropriate OS proposition, we extract the property of being a place y and a time t such that if it is thundering in y at t, then it is raining in y at t, and fill in values for y and t[45].

In summary, Speaker can use stereotypical trends which he counts among his knowledge, which by definition are not falsified by any one given case, to evaluate the prejacent by deriving specific cases by assigning values to x in the property, *if a'(x) then p'(x)* embedded under the stereotypical trend marker. Each proposition in the OS is taken to be derived from a stereotypical trend in the modal base in this way. The relationship between propositions representing a stereotypical trend and an OS proposition is that of a general trend to a specific case.

As in the case where it was not raining in Sapporo even though it was thundering, some propositions, or cases, in the ordering source will be false at all accessible worlds, so we cannot simply intersect the set of accessible worlds with the set of ideal worlds and say those worlds are the best.[46] If we tried, even if none of the propositions in the ordering source itself were contradictory, when we intersected them with the set of accessible worlds we would get the empty set. Since necessity is analyzed as universal quantification over a set of worlds, if we took necessity statements to quantify over all worlds in the intersection of the accessible worlds and the ordering source propositions, all necessity propositions would be true and a parallel existential quantification of possibility would result in all possibility propositions being false.

To avoid this unwanted consequence, we have to determine for each accessible world w, how many and

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[44] In general, we can expect the specific values to be filled in by the modal assertion, which, as we will see in 3.3.1-3, by definition contains an instantiation of *p'(x)*.

[45] The fact that a stereotypical quantifier ranges over some individual-type variables while other individuals in the property have a fixed reference will be a product of the accumulated experience of the individual whose stereotypical ordering source is in question. For instance, in (d) we have a stereotypical trend specific to Bob. A person who does not know Bob, or thinks that Bob is a person who often skips out on his plans, will not be count this trend among their knowledge, though they may be able to derive it from a more general trend where instead of "Bob" an appropriately restricted free variable (e.g a person y and y is punctual) is used.

[46] The ideals themselves may contradict each other, giving even more backing to this point.

which OS propositions are true at *w*. Counting worlds in this way allows us to use the fact that the OS propositions are not true in every accessible world to sort contextual possibilities by modeling them as propositions (i.e. sets of worlds). The standard for ranking accessible worlds will be described in detail in the next section, but basically if a contextual possibility (a proposition which contains at least one accessible world) contains at least one accessible world which was also not outranked as a result of the OS-based counting just described, it is a human possibility. If it does not contain such a world, it is a slight possibility (i.e. although it is a contextual possibility, it is not a human one). This is what ordering semantics does for us[47].

Up until now I have focused on the double relativity aspect of human modality. In the next section, we'll explore the ordering function. We will see that it not only allows the differentiation of contextual possibilities based on potentially false premises, but also provides a way to not just evade but give an empirically satisfactory explanation of conflicts in our expectations and how we resolve them. The ordering function was originally designed to solve paradoxes in deontic logic, but we will see that it is also essential for modeling stereotypes.

2.2.3 Ordering based on potentially false propositions

The ordering function below is a general function which operators over all possible worlds, ordering them according to how close they are to the ideal represented in a given set of propositions.

Def. 18 A Strict Partial Order

For any set of propositions P,

$\forall w',w'' : w' <_P w''$ iff $\forall p \in P\,(w'' \in p \rightarrow w' \in p) \wedge \exists p \in P\,(w' \in p \wedge w'' \notin p)$

By this definition, *w'* is ordered before *w''* with respect to *P* iff all propositions in *P* that are true at *w''* are also true at *w'* but at least one is true in *w'* that is not also true in *w''*

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[47] See (Kratzer, 1977) (alternatively, there is an updated version in Chapter 1 of (Kratzer, 2012)) for some alternatives and their downfalls. This is a foundational work in Kratzer's development of ordering semantics for modality.

This function takes each possible world and counts which and how many propositions in a given set of propositions are true at it and orders them based on that. Therefore, if we put the set of accessible worlds through this function, and a given member of the given set of propositions *P* is false at all accessible worlds, it will not affect the relative ordering of the accessible worlds. For example, even if the proposition in the set is "if it's thundering in Sapporo, it's raining in Sapporo," is among the ordering source propositions P, if we know that it is thundering but not raining in Sapporo, that proposition will be false at all accessible worlds. However, if it also contains "if it's thundering in Tokyo, then it's raining in Tokyo" and we know that it's thundering in Tokyo but aren't sure if it's raining or not, then those worlds where it's raining in Tokyo will be ordered higher than those where it is not.

Note that the ordering function can produce intermediate ranks. Intermediate ranking worlds require consideration for modal utterances which compare non-complementary propositions. For instance, a proposition *q* compatible with ordering source propositions *a*, *b*, *c* (i.e. a proposition which includes at least one w_{abc} world) can be defined as a better possibility than a proposition *r* compatible with only *a*, *b*, which is in turn defined as a better possibility than a proposition *m* compatible with only *a*. In this case, according to the ordering function, and presumably to intuition, we could say "*r* is a better possibility than *m*."

Since the current investigation focuses on human modality, whose necessary and sufficient conditions are in terms of whether *p* and ¬*p* are compatible with or entailed by the max set, so distinguishing the set of accessible worlds which are not outranked from the rest of the accessible worlds is sufficient for our purposes. Therefore, modeling after other authors, I shall simplify the truth conditions of necessity and possibility by using a selection function, which I call *max$_P$*, to select the subset of the set of accessible worlds composed of only the stereotypically highest ranking worlds.

Def. 19 Selection Function

For a given strict partial order $<_P$ on worlds, define the **selection function max$_P$** that selects the set of $<_P$ -best worlds from any set X of worlds:

$\forall X \subseteq W : \max_P (X) = \{w \in X : \neg \exists w' \in X : w' <_P w\}$.

Applied to possibility modals, the value of X above is the intersection of the propositions in the modal base f, and the strict partial order $<_P$ is based on the ordering source g. All the worlds in $\cap f$ are ranked by $<_g$ and those worlds which are closest to the ideal encoded by g are selected. This set will be referred to as "the max set." For a stereotypical ordering source, these will be the maximally stereotypical worlds.

Def. 20 Max Set

For any set of accessible worlds $\cap f$ and ordering source g, the **max set** shall refer to $\max_g(\cap f)$, the set of worlds selected by the selection function in **Def. 19**

Thus, ordering allows us to derive a max set composed of only the accessible worlds which are maximally ideal and never results in the empty set (unless the set of accessible worlds itself is empty). This brings us to another problem: contradictory ideals. In the next section, we will look at how the partiality of the ordering function accounts for contradictory stereotypes, such as when a situation predicts that raining and not raining are both stereotypical.

2.2.4 Contradictory expectations and a partial order

Laws sometimes contradict themselves, but they are in general designed not to do so. Stereotypes, on the other hand, are full of contradictions, and this has a big effect on how we use epistemic modals. We saw that a deontic ordering source including "If John is a citizen, he votes" leads to the truth of "John must vote." Given this, if a stereotypical ordering source includes "if it's thundering in Tokyo, it's raining in Tokyo," and there are accessible worlds where "it's raining in Tokyo" should this not result in, "It must be raining" being true? It can lead to this conclusion, but since there are also many ways that "it's not raining in Tokyo" might also be a stereotypical state of affairs, there will be many instances where it does not. Speaker is aware of this. This is modeled in our semantics by the partiality of the ordering function.

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We form associations by pulling out commonly co-occurring characteristics of states of affairs and associating them. For instance, we might associate thunder with rain if we have a lot of experiences where thunder and rain co-occur; we might associate sunny weather with no rain if we have a lot of experiences where sunny weather and no rain co-occur. Given that we did so, these associations would not require that thunder and sun never coincide (though we may form such an association separately), so we would get two generalizations which can collide in any given state of events.

When there are no conflicting associations, for instance it's sunny but not thundering, there is no problem. However, when we have conflicting associations, we will be able to assess the situation based on either of them. For instance, at a given point in time, we might think rain in Tokyo is a normal state of affairs because it's thundering, but at the same time think it abnormal because it is sunny. Ordering semantics can handle these situations thanks to the partiality of the ordering function.

For any two worlds, w_1 and w_2, if there is an ordering source proposition which is true in one but not the other, and the reverse also holds, no order can be established between them (see Def. 18, p. 63). In this case, there are two subsets of worlds which are completely ranked with respect to the ordering source, where each subset is defined according to its highest ranking set of worlds. One of these sets will contain w_1 but not w_2, while the other will count w_2 but not w_1. Lower ranked worlds may or may not be shared among such subsets.

To be clear, this ordering function disregards any notion of priority of one ordering source proposition over another; it can neither affirm nor rule out that one ordering source proposition might somehow be more important than the other. As a consequence, for an OS including propositions a, b, c, and d, even in a case where 3 OS propositions a, b, and c are true in w' and only 2 OS propositions a and d are true in w'', w' and w'' cannot be ordered w.r.t. one another since there is a proposition true in each of them that is not true in the other. In this case we would have two subsets of $\cap f$ which are internally completely ordered w.r.t. g but completely unordered with respect to each other.

This ordering is schematized in Figure 3 below. All worlds listed in the figure are accessible. w_{abc} is the set of accessible worlds where propositions a, b, c and $\neg d$ are true, w_{ab} where a and b, $\neg c$ and $\neg d$ are true, etc. w_ are worlds

where none of the ordering source propositions are true. For expository purposes we will suppose that there are no worlds where both b and d are true or where both c and d are true. Given these assumptions, there are two subsets of highest ranked worlds, w_{ad} and w_{abc} as seen in Figure 3. Ordering sequences branching from these are colored accordingly. Subsets of worlds are listed more than once because they appear in multiple, distinct ordering sequences.

Figure 3 Two Disconnected Branches of Ranked Worlds

w_{ad}			$<_P$	w_d	$<_P$	$w_{\_}$
w_{ad}			$<_P$	w_a	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{ab}	$<_P$	w_a	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{ab}	$<_P$	w_b	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{ac}	$<_P$	w_a	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{ac}	$<_P$	w_c	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{cb}	$<_P$	w_b	$<_P$	$w_{\_}$
w_{abc}	$<_P$	w_{cb}	$<_P$	w_c	$<_P$	$w_{\_}$

Let us also consider a case where, in addition to d being incompatible with b and c, there are no worlds in $\cap f$ where a, b, and c are all true ($\neg\exists w: w \in \cap f \ \& \ w \in (a \cap b \cap c)$). Since $\cap f$ does not include any worlds w_{abc}, these worlds do not get ordered by $\max_g(\cap f)$ and thus there can be no ordering relative to w_{abc}. This means there would be four subsets of mutually unorderable ranked worlds instead of two. This is schematized in Figure 4.

Figure 4 Four Disconnected Branches of Ranked Worlds

w_{ad}	$<_P$	w_d	$<_P$	$w_{\_}$
w_{ad}	$<_P$	w_a	$<_P$	$w_{\_}$
w_{ab}	$<_P$	w_a	$<_P$	$w_{\_}$

		w_b	$<_P$	$w\_$
w_{ac}	$<_P$	w_a	$<_P$	$w\_$
		w_c	$<_P$	$w\_$
w_{cb}	$<_P$	w_b	$<_P$	$w\_$
		w_c	$<_P$	$w\_$

We shall refer to each subset, grouped according to its highest ranking worlds, as a branch of ranked worlds and to two or more mutually unorderable subsets as disconnected branches.

Def. 21 Disconnected Branches (of Ranked Worlds)

For any modal base f and ordering source $g = \{p_1, p_2 \ldots p_n\}$, for any p_i, p_j such that $1 \leq i,j \leq n$ and $p_i \cap p_j \cap (\cap f) = \varnothing$, if there is at least one world w_i in $\cap f$ where p_i is true and one world w_j where p_j is true, w_i and w_j and the two subsets of worlds which are completely ordered relative to w_i and w_j shall be referred to as disconnected branches of ranked worlds.

Disconnected branches are important for possibility because they allow a proposition and its complement to both be true in some maximally ranked world, though never in the same maximally ranked world. Looking at Figure 3 and Figure 4, we can see that each rise in rank results from the complement of one of the OS propositions being true throughout the lower ranked subsets of worlds; for instance, w_{ad} worlds are better than w_a worlds because the complement of d is true in all w_a worlds. If w_{ad} worlds are compatible with the set of accessible worlds, there will be a branch of ranked worlds in which no $w_{\neg d}$ world, regardless of how many other OS propositions are true in it, would be included among the set of that branch's highest-ranked worlds.

In the case that there are disconnected branches of ranked worlds, the subset of those worlds which are ranked highest within at least one branch is selected for the max set. For example, in Figure 3 and Figure 4, that subset of accessible worlds containing the leftmost sets of worlds subsets would all be selected. Consequently, there will be

cases where no one OS proposition is true in all worlds in the max set.

Stereotypical ordering sources as I have depicted them include conditionals whose consequents can be the prejacent and/or its complement, e.g. *If it's thundering in Tokyo then it's raining in Tokyo* and *If it's sunny in Tokyo then it's not raining in Tokyo*. Since it is possible for two conditionals whose consequents are a proposition and its complement to be true in a single world, conditional OS propositions do not guarantee disconnected branches. However, any worlds where both the antecedents are true can only satisfy at most one of the conditionals' truth conditions. If the set of accessible worlds is restricted so that the antecedents are true in all of them, we get disconnected branches.

Returning to the problem we ran into at the beginning of this section. Even if Speaker knows that it is thundering and believes that this thundering is positively associated with raining, unlike in the law example considered earlier he will not necessarily assume that this makes "it is raining" a necessity. This is because he has not ruled out that there are other characteristics of the situation which are positively associated with "it is not raining." For example, perhaps he has also noticed that it's sunny out and takes sun to be positively associated with an absence of rain. As long as he has not ruled out such a possibility of a disconnected branch of ranked worlds where "it is not raining" is true being among its top-ranked worlds, he will not say *It must be raining*.

2.2.5 Section summary

The goal of this section was to make the stereotypical conversational background as explicit as possible and show that doing so requires the use of ordering semantics. We saw that in general the key function of the ordering source serves to sort contextual possibilities into human and slight possibilities, and that it is able to do this because the propositions that comprise the ordering source are not necessarily true (i.e. not true in all accessible worlds). This leaves open the possibility of some of its propositions being false in all accessible worlds, and an ordering semantics addresses this problem. This was necessary for stereotypical conversational backgrounds just as it was for deontic conversational backgrounds.

We also showed that unlike law-based deontic conversational backgrounds, stereotypical conversational

backgrounds are not finite lists and have no need to be in order to fulfill their function as an ordering source. Furthermore, since stereotypical states of affairs reflect associations which are formed by associating frequently co-occurring characteristics, not all characteristics, of a state of events, they give rise to contradictory expectations. We saw that ordering semantics can also model this, by generating disconnected branches of ranked worlds. Whenever Speaker believes there could be a disconnected branch where the complement of the prejacent in his modal assertion is true, he will use *may/might* instead of *must*.

Given what we have seen, the inability to find explicit truth conditions given a stereotypical ordering source does not adversely affect its function as an ordering source. On the contrary, incorporating an ordering semantics seems to be the only way to sort contextual possibilities based on our manifold and often contradictory expectations of how the world operates.

(optional) A run through of how a max set is chosen based on a modal base

The necessary concepts have now all been introduced. For those readers who are having trouble understanding how the max set is selected based on the modal base and the ordering source, this section may be helpful. For those readers who already understand, this section may be skipped.

In this section, we shall examine a linguistic example of ordering and max set selection. Very different results are obtained for the max set depending on which worlds are accessible from the modal base. Before examining how the modal base affects the max set, we shall see how different mutually incompatible propositions (i.e. distinct cells of a partition) differ in their compatibility with the propositions in g (repeated from above). Each w_n is taken to be the set of all worlds in which the propositions listed next to them are true (e.g. w_1 below is the set of all worlds in which it's thundering, it isn't sunny, and it rains.) I have also listed the most inclusive non-empty intersection with the ordering source propositions for each partition. The more inclusive intersection to which a world is a member, the higher is its rank. Those subsets which are compatible with both ordering source propositions are underlined. To simplify exposition, we will abstract away from the time and place values in the ordering source propositions for this exercise.

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g = { p_1| If it's thundering, it's raining ; p_2| If it's sunny, it's not raining }

w_1: *It's thundering but not sunny, and it is raining,*

$$w_1 \cap p_1 \cap p_2 \neq \varnothing$$

w_2: *It's thundering but not sunny, and it is not raining,*

$$w_2 \cap p_2 \neq \varnothing$$

w_3: *It's sunny but not thundering, and it is raining,*

$$w_3 \cap p_1 \neq \varnothing$$

w_4: *It's sunny but not thundering, and it is not raining,*

$$w_4 \cap p_1 \cap p_2 \neq \varnothing$$

w_5: *It's sunny and thundering, and it is not raining,*

$$w_5 \cap p_2 \neq \varnothing$$

w_6: *It's sunny and thundering, and it is raining,*

$$w_6 \cap p_1 \neq \varnothing$$

w_7: *It's not sunny and not thundering, and it is raining,*

$$w_7 \cap p_1 \cap p_2 \neq \varnothing$$

w_8: *It's not sunny and not thundering, and it is not raining,*

$$w_8 \cap p_1 \cap p_2 \neq \varnothing$$

Next we will look at how the max set is selected.

I.   For f = {W}, $max_g (\cap f) = w_1 \cup w_4 \cup w_7 \cup w_8$

Given an empty modal base, i.e. if f contains only the empty proposition true at every world, all possible worlds

(i.e. all worlds in W) are accessible. In such a situation, the highest ranking accessible worlds are w_1, w_4, w_7, and w_8

worlds since both propositions in the ordering source are true at them. Since they are members of exactly the same

ordering source propositions, they are equally ranked w.r.t. one another.

II. For f = { it's thundering; it's not sunny }, $max_g(\cap f) = w_1$

If only thundering but not sunny worlds are accessible from the modal base, i.e. if the modal base contains the propositions that it is thundering and that it is not sunny, only w_1 and w_2 worlds are accessible. Both p_1 and p_2 are true at w_1 worlds, but only p_2 is true at w_2 worlds, so w_1 worlds are ranked higher than w_2 worlds.

III. For f ={ it's sunny; it's not thundering }, $max_g(\cap f) = w_4$

If only sunny but not thundering worlds are accessible from the modal base, only w_3 and w_4 worlds are accessible. Both p_1 and p_2 are true at w_4 worlds, but only p_1 is true at w_3 worlds, so w_4 worlds are ranked higher than w_3 worlds.

IV. For f = {it's sunny; it's thundering }, $max_g(\cap f) = w_5 \cup w_6$

If only sunny and thundering worlds are accessible from the modal base, only w_5 and w_6 worlds are accessible. Since they are each compatible with a different ordering source proposition, they are not orderable w.r.t. one another. We can't say that one is better than the other, or even that they are equal to one another. We can only say that they are both stereotypically highest ranking worlds.

V. For f = { it's not sunny; it's not thundering }, $max_g(\cap f) = w_7 \cup w_8$

If only not sunny and not thundering worlds are accessible from the modal base, only w_7 and w_8 worlds are accessible. Since both ordering source propositions are true at both of them, they are both selected for the max set.

As the above shows, we get different max sets for the same ordering source depending on what facts are included in the modal base.

2.3 Chapter summary

In the larger picture, the goal of this dissertation is to explain the discourse behavior of utterances expressing epistemic modality by showing how epistemic modality interacts with the common ground and the cooperative principle. In order to do that, it is first necessary to choose a semantic theory. The goal of this chapter was to show that a semantic theory based on human modality is the best theory for modeling epistemic modality based on

empirical necessities. In 2.1 we examined entailment relations in discourse. In section 2.2 we determined that doubly-relative modality requires a way to sort possibilities, and that an ordering source allows us to model how they are actually sorted in practice. That is, an ordering source paired with an ordering function allows us to sort possibilities based on ideals, which are potentially false and potentially contradictory.

We first saw that doubly-relative modality is necessary to account for non-contradictory use of *must ¬p* and *may p* by a single individual in discourse. More specifically, we saw that as a theoretic construct doubly-relative modality provides 5 different possibility configurations, which can be taken to represent consistent, maximally filled-out belief states regarding the possibility of a given proposition, and that these configurations reflect the entailment relations observed in a given individual's utterances over the course of a discourse event. This served as evidence against proposals for singly-relative epistemic modality.

We then showed that allowing the ordering source to take the empty set as its value allows one denotation, human possibility/necessity, to express the content of what we had been referring to as contextual modality in addition to human modality through relativization to a non-null ordering source. We thus preserved the duality of *must* and *may* (i.e. that they have the same denotation except for force) while allowing them to not always contradict one another when they have complementary prejacents in discourse. This also allows us to account for observations regarding the weakness of *must* utterances with respect to non-modal utterances using the maxims of quality and quantity from the conversational principles rather than a lexical presupposition.

We then moved on to defining stereotypical ordering sources based on (i) the need to sort possibilities, which is functionality we require of ordering sources in general, and (ii) the nature of how we form expectations of normalcy. We saw that an ordering source needs to sort contextual possibilities, but that it doesn't necessarily have to provide clear truth conditions to Hearer for every utterance. We saw that using ideals, which are potentially false, in a second conversational background allows us to give a differential order to accessible worlds, since unlike known facts, the propositions represented by ideals will not all be true in all accessible worlds. However, since this also means that some of propositions in the second conversational background can be false in all accessible worlds, we saw that we need ordering semantics. This was a general requirement of doubly-relative semantics and of ordering sources in

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general.

We then observed that since stereotypes are the result of subjective experience, they are replete with potentially contradictory expectations. We showed that the partial ordering function accounts for this by creating disconnected branches of ranked worlds. Speaker's stance regarding the presence or absence of disconnected branches was suggested to be a major factor of Speaker's choice of modal force for his expression.

The ability of a semantic theory based on human modality relative to a stereotypical ordering source to meet all the demands above gives strong evidence for its validity for epistemic modals. Nevertheless, I have not yet shown how these semantics allow human modality assertions to function as objective proposals for the common ground. As it stands we have two sets of propositions determined by Speaker's beliefs/knowledge which sort contextual possibilities. Since Hearer cannot be sure of what propositions are in either of these sets, how can she make any conjectures about what change to the common ground Speaker is proposing?

In particular for human possibility, as long as Speaker does not know any proposition which contradicts the prejacent or an ordering source proposition with the prejacent as its consequent, he can truthfully assert a human possibility assertion. Thus, the semantics of a possibility utterance alone cannot do any more than tell Hearer that Speaker does not know that the prejacent is not a stereotypical state of affairs.

In the next chapter, I will frame this semantic-pragmatic interface problem in a Stalnakerian discourse model and show that it does not bring human modality semantics closer to the discourse effects observed for modal assertions. I will then show how the literature has addressed different aspects of the gap between discourse effects and semantics, focusing on two central endeavors: describing and explaining its speech act effects and finding suitable truth conditions for it. Finally, I will make my proposal, and show that simply applying the quantity-quality maxim to human modality semantics in a Stalnakerian discourse model can explain all of these problems.

Chapter 3 Stalnakerian assertion and modal sentences

An assertion is a goal-oriented action undertaken by Speaker in a conversational exchange. The typical goal is contributing information to Hearer and/or a common pool of beliefs among discourse participants in order to further some purpose motivating the exchange. Grice describes this behavior as guided by the cooperative principle.

> Our talk exchanges do not usually consist of a succession of disconnected remarks, and would not be rational if they did. They are characteristically, to some degree at least, cooperative efforts: and each participant recognizes in them, to some extent, a common purpose or set of purposes, or at least a mutually accepted direction. This purpose or direction may be fixed from the start (e.g., by an initial proposal of a question for discussion), or it may be so indefinite as to leave very considerable latitude to the participants (as in a casual conversation). But at each stage some possible conversational moves would be excluded as conversationally unsuitable. We might then formulate a rough general principle which participants will be expected (ceteris paribus) to observe, namely: Make your conversational contribution such as is required at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged. (Grice, 1989, p. 26)

For typical linguistic exchanges, Speaker and Hearer are mutually expected to be cooperative, and part of that expectation is making sincere (as per the quality maxim) and informative (as per the quantity maxim) contributions. However, modal assertions, in particular assertions of possibility, seem to present a problem with respect to the quantity maxim. This is true even with Kratzer's doubly-relative definitions which use two conversational backgrounds to pick out a restricted set of worlds. For any set of ideals and any proposition p, if some combination of the relevant facts in the modal base and the ideals constituting the ordering source do not directly contradict p, p will always be compatible with the set of worlds picked out based on the ideal, i.e. with the max set. Thus, it would seem that as long as Hearer does not mistakenly believe that the prejacent is false, it should not be possible to derive new information based on

an assertion of possibility.

To make sense of why this is so, we shall stray from typical conversation for a moment. John and Taro are quietly walking down the street in Tokyo after a long day of lectures. John suddenly says (19).

(19) It may be raining in South Africa.

Taro is baffled at John's sudden outburst, but has no reason to doubt its truth. In this context, Taro knows that neither John nor himself know that the prejacent is false, and that they do not have any knowledge which would suggest that it is, or is not, raining in South Africa. Indeed, it would be very difficult to find a context outside of South Africa where either of these conditions were met. Thus, instead of doubting the truth of the outburst, he decides John is just a horribly inept conversationalist. Indeed, there is very little that would make John's utterance false and correspondingly very little information contributed by it. It is thus a violation of CP.

However, this is not how a typical, or even a mildly random possibility assertion proceeds. We shall consider a conversationally unrelated assertion which nonetheless addresses a proposition about which the utterer is believed to have some relevant knowledge. John and Taro are walking down the street in Osaka, a city to the west of Tokyo. John knows that Taro has relatives in Tokyo that he talks to occasionally. Taro suddenly says (21).

(20) that it snowed in Tokyo this July[48]
(21) It may have snowed in Tokyo this July.

Given facts such as that snow usually occurs during cold weather and that Tokyo is very hot in July, (20) is certainly unlikely, but it is not impossible. This time, John knows that Taro might have knowledge which indicates that snow occurred in July. Unlike (19), when John accepts (21), in some respect he also generally accepts (20) as "more" possible than it was prior to the utterance. A typical assertion asserts the truth of its propositional content, so this effect is not

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[48] The *that* indicates that it is an unasserted proposition.

predicted by the truth conditions of human possibility, whether its ordering source is null or non-null. All that is required to satisfy the truth conditions is that Speaker not know any proposition that contradicts the prejacent or that entails the antecedent of a stereotypical ordering source proposition whose consequent is the complement of the prejacent. Thus, human modality semantics, on its own, does not explain why there should be a difference between (19) and (21).

The difference, I will argue, can be found in an examination of how the maxims of quantity and quality interact with the common ground and the semantics of human modality. Possibility assertions are usually interpreted to be in line with the maxim of quantity such that, at a minimum, they contribute new information, but in the case of (19) the common ground and the quality maxim did not allow an informative reading. In the case of (21), though it also seems abrupt and of minimal interest to John, the common ground did at least allow for the assertion to be informative.

In order to show how this works, I will first explain how assertion works in a Stalnakerian model of discourse and that this characterization of assertion, which is a proposal to add the content of the asserted proposition to the common ground, is not enough to explain the effects modal assertions have on the common ground. After that I will introduce a variety of issues concerning modal assertions raised in the literature (not limiting myself to literature working under a Stalnakerian framework). Finally, I will show how the method highlighted in Chapter 1 can offer a unified answer to many of these issues and do away with the fragmented solutions proposed in the literature.

3.1 Assertions and the common ground

The Gricean maxim of quantity requires that Speaker make his contribution as "informative as is required". Stalnaker (Stalnaker, 1973, 1978, 1996, 2002), who characterizes assertions as proposed additions to the common ground, offers a more explicit representation of informativity. According to this definition, Speaker must believe a proposition will bring a change to the common ground in order to assert it. What must be the case for a possibility proposition to bring a change to the common ground?

Epistemic modals quantify over a modal base-derived set of accessible worlds and a stereotypical max set

derived from a participant's knowledge, which has no essential ties to the common ground. In following, effects on the common ground are described in terms of participant knowledge, and so an utterance of *may p* adds to the common ground, "Speaker's knowledge does not contradict *p*." However, modal possibility assertions seem to have systematic effects on the common ground which this addition alone cannot explain. This section will be dedicated to detailing this problem.

3.1.1 What is common ground?

Context is a big concept. In our denotation of *may/might*, we use it as an interpretation parameter which picks a relevant individual whose knowledge is quantified over. There are many other ways it is used and modeled, each focusing on aspects relevant to different phenomena. This study aims to explain the effects of possibility utterances in discourse. Some pertinent questions are, how does what we say affect what others come to believe and know and how does what others know and believe affect what we say? To address such questions, we will adapt a Stalnakerian (1973, 1978, 1996, 2002) model, which frames context as dependent on the set of common beliefs of the participants of any given speech event. Stalnaker defines a common belief as follows.

"A proposition θ is common belief of a group of believers if and only if all in the group believe that θ, all believe that all believe it, all believe that all believe that all believe it, etc."(Stalnaker, 2002, p. 704)

The set of common beliefs is called the common ground. The context, formally referred to as the "context set," is defined as the set of all worlds which are compatible with the propositions in the common ground. Even restricted by the common ground, in practice any given context set is compatible with an infinite number of possibilities. This model adopts a possible worlds framework, which models possibilities by supposing an infinite number of possible worlds, where each world can be identified with a unique array of truth value settings for every basic proposition. In referring to the context and changes to it, we can focus on the propositional content of the common ground, or on the set of worlds in the context set. This is identical to the relationship between the modal base and the set of accessible worlds we saw in Chapter 1.

Of course, as humans, we do not and cannot have explicit beliefs about the infinite number of propositions needed to completely characterize the actual world. For instance, it is often the case that researchers are oblivious to the weather. In this case, since the common ground among such a group of researchers contains no propositions about the weather, the context set is unrestricted w.r.t. to the weather and hence would include worlds of any weather. In this way, at any given moment, there are any number of possible worlds included in the context set which differ from the actual world simply because the beliefs of the discourse participants do not specify many of the characteristics.

Additionally, in most cases some participants may have different beliefs or knowledge about the world than others. One individual may believe proposition θ to be true, but unless all individuals believe it and that all participants believe (that all participants believe...) it, it is not common ground. The common ground may not fully correspond to the set of beliefs of any one given participant. For example, researcher John may believe that it's raining outside based on a weather report in the newspaper or because he saw it was raining when he looked out the window. However, he may also believe that no one else has this belief because they've been reading research articles in a room with no windows all day. In this case, the common ground would not include that it is raining. John would then be in a position to make an "assertion."

3.1.2 What is an assertion?

Stalnaker suggests that an essential function of assertions is to add new propositions to the common ground. In his seminal 1978 paper on assertions, he compares assertions to moves in a game.

> "One may think of a non-defective conversation as a game where the common context set is the playing field and the moves are either attempts to reduce the size of the set in certain ways or rejections of such moves by others" (Stalnaker, 1978, p. 88).

Asserting a proposition means trying to get all other discourse participants to believe that it is true. If successful, the number of common beliefs increases to include the asserted proposition, and the context set is restricted to

exclude worlds where the proposition is false. This presumably brings the common context set closer to including only the actual world. In this process, Speaker is expected to be engaged in rational conversation, which entails certain principles. Our focus will be on the following one.

A proposition asserted is always true in some but not all of the possible worlds in the context set.

(Ibid., p. 88).

Formally, this requirement is equivalent to saying that an asserted proposition must be a contextual possibility but not a contextual necessity, though it is relative to the common ground instead of an epistemic modal base. This simply means that Speaker asserts propositions which are not already believed to be true or false in the common ground, that is, he asserts propositions that he believes will update the common ground

Above, we saw that John believed it was raining and that according to him everyone else did not have a belief about the rain. This means that the context set includes worlds where it is raining and worlds where it is not raining. This put John in a position to assert that it is raining and update the common ground. He might do this by uttering (22a) below.

(22)   a: It's raining.

        b: I see.

        b': No, it's not! This room is full of sunshine.

(22a) tries to add the proposition, "It is raining" to the common ground. (22b) accepts the proposal and (22b') rejects it. Upon registering (22a), barring cases where Hearer believes that Speaker is being deceptive, "Speaker believed at utterance time t that it is raining" is automatically added to the common ground. That is, Speaker's second order belief of the asserted proposition is automatically added to the common ground[49]. This is a manifestation of

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[49] A 1st-order belief is a belief whose object is a proposition that itself does not contain any other beliefs as part. A 2nd-order belief is

Grice's quality maxim, that Speaker not assert what he does not believe. Grice's maxims can be represented in Stalnaker's framework as default members of the common ground.

When Speaker makes a non-modal assertion he is claiming that it is true in the actual world. As the old platitude, "take everything with a grain of salt", shows, this claim may or may not be sufficiently justified[50], but this is a judgment to be made by Hearer and is not included in the utterance meaning. Thus, Hearer reacts to the second-order belief of Speaker, i.e. to Speaker's belief that the proposition is true, and depending on her trust in Speaker with regards to the asserted proposition and her perception of what she perceives to be his justification for the claim, she will either accept it or reject it. In either case, the automatically-added 2nd order belief would remain in the common ground as per the quality maxim.

Supposing (22b) was uttered in response to Speaker's (22a), the common context comes to exclude all possible worlds where it is not raining. It also excludes worlds where Speaker and Hearer do not believe that it is raining. *It is raining* is now part of the common ground. Acceptance is the less-marked reaction in conversational exchanges, and is frequently assumed unless there is an explicit rejection.

In Stalnaker's game, rejections are also active moves. Supposing (22b') is uttered instead of (22b), (22a) is not added to the common ground. Instead, "Hearer does not believe that it is raining" is added as a 2nd-order belief, and Speaker and Hearer must undergo further negotiation to decide which belief to adopt, or agree to disagree, in which case the context set continues to have possible worlds where it is raining and others where it is not raining.

At the observational level, rejections are largely reflexive reactions by Hearer in order to maintain an accurate common ground. In typical conversations, no single individual can unilaterally dictate what goes into the common ground. If Hearer disagrees, unless Speaker can convince her to withdraw her rejection, the context set will not change in the way Speaker has proposed. On the other hand, if there is no overt sign of rejection, verbal or non-verbal, Speaker can typically assume his proposal has been accepted. Since the best any individual can knowingly

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a belief whose object is a 1st-order belief, and so on, with the ordering increasing for every layer of embedding.

[50] Cross-linguistically, languages which are rich in evidentiality have different morphology for declarative forms depending on the nature of the justification. English does not seem to possess this characteristic, but see (Westmoreland, 1995) for a suggestion that *must* is evidential.

achieve is a change to the common ground, and since in the case of multiple participants they will all only knowingly agree on those propositions in the common ground, not their individual beliefs, it seems appropriate to characterize discourse as a process which is centered on adjusting the common ground and not a given individual's beliefs, though of course individual belief changes may also occur.

This system works very nicely for unembedded, non-modal propositions. Accepting an assertion means adding its truth conditional content to the common ground. However, there is more room for complication when we consider attitude verbs. Do assertions of attitude verbs only require the truth conditional content of the matrix clause to be added? What is the status of the embedded proposition? Consider (23) below.

(23) I believe it's raining.

Like (22), (23) also attempts to add the uttered proposition to the common ground. At the moment of utterance, "Speaker believes that Speaker believes it's raining" is added automatically and, based on this, Hearer must evaluate whether to accept the asserted proposition as a 1st-order belief. Including (23) in the common ground entails that: "all in the group believe that *Speaker believes that it's raining*, all believe that all believe that *Speaker believes that it's raining*, all believe that all believe that all believe that *Speaker believes that it's raining*, etc. "

In following, direct rejection of the asserted proposition would remove *Speaker believes/knows it's raining* from the common ground[51]. Unlike (22), acceptance and rejection of (23) does not require Hearer to have any specific belief regarding the proposition that it's raining. (23) includes an embedded proposition, but the target of the assertion is the matrix proposition. In this case, acceptance results in the addition to the common ground of a 2nd order belief, "*Speaker believes p*" which is not a 1st order belief.

There are also cases where the embedded proposition is highly relevant to some question being discussed, in

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[51] Of course, this would leave the automatically added "Speaker believes that speaker believes that it's raining," which implies (entails?) that the matrix proposition is true, so such a rejection would only be practical in situations where Speaker's sincerity is under question.

which case, discourse participants will be impelled to evaluate the embedded proposition as well[52] (cf. Abrusan, 2011; Arnand, Hacquard, Crnič, & Sauerland, 2014; Simons, Tonhauser, Beaver, & Roberts, 2010). In this case, an *I believe p* assertion can sometimes result in *p* becoming a 1st order belief in the common ground. Nonetheless, the matrix proposition will be proposed for addition to the common ground in all discourse contexts, not just some. Thus it seems that both attitude statements and of non-modal unembedded sentences are proposals to add the truth conditional content of the matrix proposition to the common ground. In the next section, we will see that modals do not straightforwardly fit into this picture.

3.1.3 Modal assertions

All assertions are proposals to add a proposition to the common ground. A human modality sentence denotes that the prejacent is compatible with/entailed by a proposition formed by the knowledge of an individual x_c (the max set). Thus, a straightforward application of assertion would mean that modal assertions are proposals for the common ground to include that, "the prejacent is humanly possible/necessary with respect to x_c's knowledge." However, treating modal assertions exactly the same as other types of assertion at first seems to miss many of their general discourse effects.

Table 4 shows the content of what is proposed for the common ground by each type of assertion. I have laid out different "levels" of acceptance in order to facilitate comparison of non-modal and modal assertions. Level 2 corresponds to Speaker's belief, or commitment, to the content of the proposition he uttered. Level 1 is the content itself, indicating that it has been accepted as a 1st-order belief by all discourse participants. Finally, we have a yet-unidentified Level 0 for modals, which is the principle topic of this chapter and the dissertation in general. For modal assertions, we will assume that x_c is Speaker.

Table 4 Proposals for CG by non-modal, 1st person belief, & and modal assertions

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[52] Note that the content that is added to the common ground if (23) is accepted is equivalent to what is added automatically when (22) is uttered. Seen this way, it is not unexpected that discourse participants would evaluate the embedded proposition as well, if the embedded proposition is relevant to the discourse.

	p	**I believe p**
2	Speaker believes that *p*.	Speaker believes that Speaker believes that *p*.
1	*p*.	Speaker believes that *p*.

	May/must p
2	Speaker believes that *p* is humanly possible/necessary w.r.t. the knowledge of x_c.
1	*p* is humanly possible/necessary w.r.t. the knowledge of x_c.
0	*p* is humanly possible/necessary.

We are primarily interested in identifying Level 0 for modal assertions. If Hearer accepts a modal assertion at Level 1, she accepts it in the same sense that she accepts a non-modal assertion at Level 1. That is, given the model of assertion presented in the previous section, Level 1 acceptance should mean that a modal assertion has completed successfully. However, as we have seen in Chapter 1 and at the beginning of this chapter, there seems to be more to modal assertions. Thus the question arises: does Level 0 for modal assertions exist and, if so, what is it and how does Hearer derive it?

Levels 2 and 1 for modal assertions and non-modal assertions differ in a way similar to how *I believe p* assertions and non-modal assertions differ. In *I believe p* and modal assertions, Speaker is asserting how a proposition *p* is related to his private belief set. Thus, it may seem as if there is little room for error by Speaker at Level 1 as compared with non-modal assertions. For instance, we are perfectly entitled to judge a claim of "John is in Canada " as false if we know that John is in Mexico, but we are usually not entitled to do so based on a claim of "based on what I know/believe, John is in Canada." which is roughly what Level 1 corresponds to for *I believe p* and modal assertions. We do not know what Speaker knows, and there may well be facts supporting "John is in Canada" and none contradicting it in Speaker's knowledge and/or beliefs.[53]

Since Hearer cannot know the complete content of Speaker's beliefs or knowledge, it is generally unlikely for

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[53] It is possible for Speaker's knowledge, identified with a set of propositions, to render a given proposition as a human necessity/possibility without Speaker realizing this. For instance, any result of complex deduction, such as the result of consecutive applications of basic mathematical rules, is susceptible to this situation. This entails that the same holds for a given proposition being impossible, since if a given proposition is necessary for Speaker, its complement is impossible for him. It is also possible for Speaker to mistakenly believe that his knowledge renders a proposition humanly necessary/possible, as in cases of failed deduction This will be an important point for differentiating between falsity at the propositional level and rejection at the speech act level.

Hearer to form a belief as to whether or not Speaker's beliefs/knowledge make a proposition humanly possible/necessary which is contrary to what he himself asserts. This suggests that it is generally likely for Hearer to accept modal assertions at Level 1. This applies to Level 2 by extension; it would also be unlikely for her to form a belief as to whether or not Speaker believes that his beliefs make a proposition humanly possible contrary to what he himself asserts, again because she cannot know for sure what beliefs he has. Since Levels 2 and 1 are inscrutable to Hearer for the same reason, they might generally be considered pragmatically equivalent for Hearer in that they are accepted automatically, barring special circumstances where Hearer believes herself to have intimate knowledge of Speaker's beliefs and how he came to have them, or where she believes he may be prevaricating.

Recall that Level 2 acceptance is automatic as long as the quality maxim is in effect. In other words, a modal assertion of *It may be raining* automatically results in, "all in the group believe that *Speaker believes that it may be raining*, all believe that all believe that *Speaker believes that it may be raining*, all believe that all believe that all believe that *Speaker believes that it may be raining*, etc." being added to the common ground. For the reasons in the above paragraph, this usually results in automatic Level 1 acceptance. Since Level 1 acceptance entails that the proposition is accepted as true, and given the model of assertion highlighted above, this should mean that the assertion has successfully completed.

This brings us back to the first part of the question in the first paragraph of this section: Does Level 0 for modal assertions exist? If Level 1 acceptance settles the proposed addition to the common ground made by modal assertions, there should be no inherent demand on Hearer to modify her beliefs regarding *p*. However, consider the following.

(24)   A: According to what I know/believe, it must be raining.

         B: I see. I'm not so sure (that it must be raining).

(25)   A: It must be raining.

         B: I see. #I'm not so sure (that it must be raining).

(26)   A: It's raining.

         B: I see. #I'm not so sure (that it's raining).

(24) and (25) should be equivalent if the proposals made by bare modal assertions were settled at Level 1. We can see that "I see," taken as an indicator of acceptance and not as back-channeling, and "I'm not so sure" (which shows reluctance by its utterer to acknowledge the truth of the asserted proposition) are contradictory for a bare necessity assertion, (25), but not for a necessity assertion with a qualifier, (24). In (24), Hearer acknowledges that Speaker's knowledge is indicative of the human necessity of "it's raining" without committing to its human necessity relative to her private knowledge. In (25), judging by the fact that "I'm not so sure" feels like a contradiction, it seems that her acceptance via "I see" entails that she has committed to "It's raining" being a human necessity relative to her knowledge (or least what she is treating as her knowledge for the discourse event) as well.

This suggests that accepting a bare modal necessity assertion typically requires more than just acknowledgement that the prejacent is necessary w.r.t. Speaker's knowledge. Furthermore, if we compare (25) with the non-modal assertion in (26), we see that they show the same acceptance pattern. Hearer's acceptance entails commitment to some first-order belief regarding the asserted proposition. In the case that there are several discourse participants, acceptance, or a lack of rejection (verbal or non-verbal), will imply first-order belief by all participants. That is, modal assertions seem to affect the common ground at the first-order belief level. Thus, the answer to our question seems to be a 'yes': Level 1 acceptance does exist, in some form. Thus, we have come to our second question: What is Level 1 acceptance?

Accepting Levels 2 and 1 entails accepting the asserted proposition's truth conditional content into the common ground. However, since a modal proposition evaluates possibility relative to an information body (the set of propositions constituting the knowledge of an individual x_c) which can and almost always will be larger than the common ground and not entirely in a truthful way (most individuals will have some false beliefs), its truth conditional content does not entail that the prejacent is humanly possible/necessary relative to the common ground. Adding to this that this information is often inscrutable to Hearer, it is not obvious how a modal assertion could systematically change the common ground on a first-order belief level. Thus, a more precise reformulation of our question seems in order:

What does a modal assertion add to the common ground?

The answer the present dissertation will offer maintains Level 1 acceptance as portrayed in this section. In particular, the modal base will be completely subjective or solipsistic. All effects which are not logical consequences of Level 1 acceptance will be assigned to what I have christened Level 0. The identity of Level 1 will be shown to be a combination of pragmatic presuppositions and accommodation.

As we will see in the next section, the previous literature has sought to answer this question by changing the proposed semantic contribution of a modal assertion as encoded here in Level 1, so that knowledge other than that of Speaker is assigned to the modal base. We will see that this approach not only creates a number of new, theory-internal riddles, but fails to account for many of the discourse effects of epistemic assertions.

3.1.4 Section conclusion

In this section we saw how the truth conditions of human modality interact with Stalnaker's framework if we try to implement it exactly as we did with non-modal assertions. We also saw that in practice, at least human necessity assertions have 1st-order belief effects on the common ground which are not predicted given this implementation and thus require additional suppositions.

However, a thing to keep in mind is that Stalnaker constructed his model with non-modal assertions and Grice's CP in mind. As such, his formalization should not be expected to apply in the same way to modal assertions, which deal with the space between known truth and falsity. A successful implementation of his system for modals requires a fresh assessment of how the interaction between the CP, the common ground and modal semantics interact.

Stalnaker's original formalization of assertion has helped to fossilize a general bias toward truth conditions as the fundamental basis for making a felicitous assertion, while other maxims are considered only after the truth conditions of the assertion have been established. Much of the previous literature has tried to explain the discourse effects of modal assertions by analyzing them not as manifestations of acts intended to contribute to the varying

information demands of discourse, but as contextualized objects with static truth values which are independent of the direction or state of the discourse, rooted in either Speaker's knowledge or the knowledge of some other individual or repository of knowledge. That is, instead of starting from the supposition that Speaker has a modal base that renders his assertion felicitous at the moment of utterance, they suppose instead that Speaker's utterance must be true and try to figure out what the minimal requirements are to make it so. Quantity demands for an assertion to contribute new information or at least the information that is being sought by the discourse event at the moment of utterance are secondary.

However, Speaker will typically not assert a modal proposition simply because he believes it is true. He utters it when he believes it is true <u>and</u> he believes it will make some meaningful contribution to the conversational exchange. In my analysis, Hearer assumes Speaker has a modal base which makes his assertion felicitous and assumes that his utterance is true with respect to this modal base. Speaker knows Hearer will do this, and so he can be confident that his assertion will be interpreted relative to an appropriate modal base. This small change in assumptions will go a long way in explaining the seemingly confusing truth judgments regarding epistemic assertions.

In the next section. I will outline previous endeavors to find adequate truth conditions for modal sentences along with endeavors to isolate pragmatic phenomena triggered by epistemic modals from the semantic content. I will conclude that success in both branches of endeavors can be achieved by an adequate delineation of what I have christened Level 0.

3.2 Riddles from the literature: Truth and falsity, assent and dissent, asserting and proffering

In this section, I will introduce two key branches of investigation in epistemic modality. One is largely theory-internal and rests in finding suitable truth conditions for an epistemic modal assertion and explaining why Hearer may disagree with Speaker despite the inherent subjectivity of such assertions. The other branch is more empirical, and tries to explain the contribution of modal assertions to discourse. Naturally, they interact, often in indirect ways, but I will do my best to lay these interactions out.

3.2.1 Truth conditions and non-solipsistic modal bases

Epistemic modality in modal logic was originally taken to be relative to "what is known." Its truth conditions were relative to all things known in the world. However, epistemic modals in natural language are uttered by individuals who do not have access to all things known, and as observations of intuitive truth judgments reflect, are not intended to be relative to this body of human knowledge. Thus, we start with the observation that epistemic modal assertions are subjective, or solipsistic. However, sometimes the truth conditions of a modal sentence seem stricter than what would be the case if Speaker's knowledge were the only knowledge they depended on. This started a quest to find the nature of the knowledge that actually is factored into the truth conditions of epistemic modal sentences in natural language. We will use the following example from (DeRose, 1991) to demonstrate.

A man John has been tested for cancer. His wife and his doctor both know that the results will either determine that he may have cancer, in which case further tests will be necessary, or that he definitely does not. The doctor has seen the results and knows that they are negative, but John's wife has not seen them yet.

(27) John might have cancer.

In this case, John's wife can truthfully utter (27) but John's doctor cannot. Thus, we have evidence that the truth of *may* depends not on all knowledge, but on Speaker's knowledge. However, if we consider the range of possible answers for John's wife, Jane, it seems we cannot be so hasty to make truth dependent on Speaker's knowledge alone. Consider the following example (cf. DeRose, 1991, pp. 584–585; von Fintel & Gillies, 2011, p. 111).

(28)   I've heard that John might have cancer. Is it true?

a   (Jane) He might have cancer

b   (Jane) <u>I don't know whether he might have cancer</u>; only the doctors know. I'll find that out

tomorrow when the results of the test are in.

If the truth conditions only require the prejacent to be compatible with Jane's knowledge (and her stereotypical ideals), it should never be the case that she does not know if something is humanly possible or not, and so a response like that in (28b) should be false. von Fintel & Gillies (2011) suggest, "Whatever information state this *might* quantifies over, it doesn't include just Jane[the speaker]'s knowledge. More objective readings--readings in which the modal quantifies over a modal base that goes beyond the speaker's information state--need to be available" (von Fintel & Gillies, 2011, p. 111)[54].

DeRose suggests that the modal base is composed of the propositions known by a "relevant speech community." If the community includes only Speaker, or perhaps only Speaker and her family, (28a) is true and (28b) is false. If the community includes the doctors, then (28b) is true and (28a) is false but not knowable by Speaker until she talks to the doctor. Hacking (1967, p. 148) presents a seemingly related problem.

A member of a salvage crew searching for a sunken ship makes some calculations based on a ship log the crew recovered and claims,

(29) "The wreck may be in this bay."

In actuality, an investigation of the logs by a less error-prone third party would have revealed that it was not possible that the wreck was in that bay. Given this information, most will judge that (29) is false. This judgment is constant even assuming that neither Speaker nor anyone in the relevant community knew that the wreck was not in the bay (or that it was not a predictable/normal/usual state of events that the wreck be in the bay). Thus, even if we adopt a modal base which is relative to a community of knowers, (29) is predicted to be semantically true. To account for this gap between truth judgment and semantics, Hacking proposed that the truth conditions of possibility are relative not only to variable communities of knowledge, but also to "practicable investigations." In this way, truth

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[54] von Fintel & Gillies have identified objectivity of an utterance with the public availability of the propositions in the modal base. This parts from the use in dissertation, which uses "objectivity" to refer to the act of proposing a proposition for the common ground.

can still be relative to a limited body of knowledge such as that of a single speaker, but can also be partially dependent on a more restrictive body of knowledge, such as that of a broader community of which Speaker is a member, or a body of knowledge contains facts which are obtainable through practicable investigations.

To summarize, (29) is claimed to be false because Speaker's claim would not hold up under a practicable investigation. Meanwhile, John's wife is claimed to be able to truthfully assert (28a) if she presents it as relative to only her own knowledge and (28b) if she presents it as relative to the doctor's knowledge, or as relative to her knowledge where there is some practical investigation which she has not undergone (such as opening an envelope containing the test results).

This solution masks a difference between (28) and (29). While John's wife would be able to say (28b) as long as there was a medical test that had been conducted to differentiating her knowledge from the doctor's, we would not typically judge (28a) as false even in the case in which she had an unopened envelope with the results in her hand as she spoke, regardless of what the results happened to be. On the other hand, most would judge Speaker in (29) as having said something false. If opening an envelope and investigating ship logs more thoroughly are both "practicable investigations," then where does this difference in intuition come from?

Another issue that making the modal base relative to communities tries to address is that even though the truth conditions are relative to some body of knowledge <u>at the time of utterance</u>, Speaker will often admit that he is wrong after gaining new information. If the utterance is relative only to Speaker's knowledge at utterance time, it should not become false by knowledge which is incremented at a later time. Consider the following from (MacFarlane, 2003, 2011).

(30)   Sally: Joe might be in Boston. (= It might be the case that Joe is in Boston.)

            George: He can't be in Boston. (= It is not the case that it might be the case that Joe is in Boston.) I saw him in the hall five minutes ago.

            Sally: Oh, then I guess I was wrong.

MacFarlane argues that if the truth conditions of Sally's utterance were relative only to her own knowledge at utterance time, she should not have to retract her assertion even if further knowledge deems it incorrect. Furthermore, George should not be able to disagree with her in the first place—who is he to say what she knows? If we assume that Sally's assertion was intended and interpreted as relative to her and George's pooled knowledge, on the other hand, then the reason George objects and the reason Sally admits she was wrong can be explained. Sally thought she knew George's knowledge, but George points out that she didn't, and if George says his knowledge is different, Sally has no choice but to admit she was wrong.

Whatever its merits, this explanation leaves us to wonder what made Sally feel entitled to make an assertion based on George's knowledge in the first place. If she intends it as relative to George's knowledge, should she not be obliged to say she doesn't know as Jane was in (28b)? MacFarlane also argues against making the truth conditions of an epistemic modal sentence relative to a relevant community offering the following argument:

> Suppose Sally says, "Joe might be in Boston," and George replies, "Oh really? I didn't know that." At this point, Jane—who is hiding in the closet—emerges and says, "Joe can't be in Boston; I just saw him down the hall." It seems entirely natural for Sally to reply, "Oh, then I guess I was wrong. Thanks, Jane." It would be bizarre for her to say, "Thanks for telling us, Jane. I guess Joe can't be in Boston. Nonetheless, I stand by what I said a second ago." Clearly Sally did not have Jane in mind when she made her claim. So if we're going to make sense of these retractions, we must suppose that the force of Sally's claim was something like: what we know—we who are or will be in a position to consider this claim—does not rule out Joe's being in Boston. (MacFarlane, 2011, p. 10)

Even when a given knower, such as Jane, is clearly not in Speaker's consideration when she makes her assertion, that knower can disagree despite obviously not being included in the community to which the proposition was intended to be relative, and furthermore Speaker will not disregard this disagreement as inconsequential for her assertion. In short, disagreement by a Hearer and a resultant correction by Speaker can occur even when the disagreement comes from an individual who could not feasibly be included in Speaker's intended community. Thus,

wide-community-relativity of the truth conditions does not account for all the observations if the community in question is required to be fixed by Speaker. Nonetheless, without a non-solipsistic reading, it seems we cannot account for felicitous assertions that one does not know whether a proposition is possible or not.

I have summarized the problems below. The leftmost items are empirical observations and the items preceded by an arrow are problems brought about by theoretical assumptions. As can be observed, the observation that epistemic modal assertions depend on Speaker's knowledge is the root of all investigation. The other observations only become problems when this point is acknowledged. When I address these points later, I will assume that the first tier observation is correct, and address the second-tier problems. As such, the third and fourth tier problems do not emerge.

Epistemic modal assertions at least sometimes depend on Speaker's knowledge.

    Truth is relative to Speaker's known propositions.

    It is possible for Speaker to "not know" whether a proposition is possible.

        -> Truth conditions are also relative to the knowledge of larger groups and/or other individuals.

            -> Why does Speaker sometimes say "I don't know" and sometimes does not?

    We sometimes judge a modal assertion as false even though it is true based on a purely subjective reading

        ->Truth conditions are also relative to practicable investigations.

            What is the difference between ship logs and opening an envelope which leads to different truth judgments?

    Speaker will admit he was wrong based on an objection based on Hearer's knowledge.

        -> The modal base must somehow include Hearer's knowledge.

            -> Why does Speaker feel justified to assert based on Hearer's private

knowledge even though he cannot know it?

-> Why can an eavesdropper disagree and why does Speaker acknowledge

his point?

In this section, we saw how truth conditional semantics has traditionally approached truth for epistemic modality. First it is observed that Speaker can make an epistemic modal utterance that is judged to be wrong. If epistemic modality is based purely on Speaker knowledge, however, then should almost never be possible since Speaker should know his own knowledge. The fact that it seems wrong can be attributed to epistemic modality being relative to a more exclusive modal base which includes Speaker's knowledge and then some. Even if assumptions of such a modal base makes possible an account for truth judgments, though, it is not argued to explain many discourse effects. These effects are explained through pragmatic devices which operate on top of the community-wide modal base assumption. These proposed explanations are the topic of the next section.

3.2.2 Interpreting modal assertions: What is Hearer evaluating?

In the last section we focused on truth conditions, which correspond to the propositional content as Speaker intends it. The topic of this section is how modal assertions are interpreted, which leads to a focus on what motivates Hearer's response and pays more attention to whether she can derive the propositional content Speaker intends. There is a growing body of research concerned with whether Hearer can comment on the truth conditions of Speaker's utterance. A common position is that Hearer can comment on them in the case of an "objective" modal assertion, but not in the case of a "subjective" modal assertion. I will use the terms "objective" and "subjective" to differentiate between instances of modal assertions according to whether they are intuitively relative to publically available information or only to private knowledge.

(Papafragou, 2006) and (Portner, 2009) try to account for the difference between objective and subjective modal assertions by supposing that in addition to solipsistic modal bases there are also "intersubjective" ones, which

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are relative to the knowledge of not just Speaker, but also that of Hearer and/or any other number of individuals.[55]

However, as they both point out, Hearer also makes judgments concerning subjective modal assertions. This is unexpected. Since Speaker's knowledge is inscrutable to Hearer, it is hard to see how the object of her evaluation could be the truth conditions of a solipsistic modal base-relative proposition. Finding a mechanism that can explain why and what Hearer is evaluating in the case of subjective modal assertions has been a central topic in epistemic modality research (MacFarlane, 2011; Papafragou, 2006; Portner, 2009; Stephenson, 2007; von Fintel & Gillies, 2011; Willer, 2013).

In this section, I will suggest that however we account for Hearer's agreement/disagreement, we should do so with the same mechanism for all assertions, objective and subjective. I will then review two proposals intended as ways to account for why Hearer can object to subjective modal assertions: (Portner, 2009)'s CPS and (von Fintel & Gillies, 2011)'s cloud of contexts. I will conclude that both leave important aspects of modal assertions unaccounted for. Namely, they miss the connection between Speaker's positive commitment, Hearer's reactions, and informativity.

I shall start by examining what the motivation is for dividing modal assertions into subjective and objective types. We will review these in turn over the next few sections, though the latter three all emerge from the 1st motivation.

1. A need to explain why Hearer feels entitled to object or agree to an assertion based on Speaker's internal knowledge

2. An observation that there are "objective" modal assertions in which Hearer can agree or disagree with the possibility status of the prejacent based on the same facts as Speaker and "subjective" modal assertions where there is no publically-available evidence, making it is unclear what Hearer could be agreeing or disagreeing with.

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[55] (Papafragou, 2006) calls such modal bases "objective," and (Portner, 2009) calls them "intersubjective." I will follow Portner in using "intersubjective" to refer to the theoretical construct of a modal base which is relative to a group of individuals including Speaker, and will continue to use "solipsistic" to refer to a modal base which is relative only to Speaker's knowledge and reserve the terms "objective" and "subjective" to refer to instances of modal assertions which are intuitively judged to be relative to publically available information or only private knowledge. This allows me to refer to both types of assertion without committing to what knowledge is included in the modal base.

3. The infelicity of embedding "subjective" but not "objective" modal propositions under factive predicates (This is taken as support for there being a need to account for the observations in (1.) linguistically)

4. Instances where Hearer seems to be addressing the prejacent and not the modal truth conditions, such as "Are you sure?", where a positive response would seem to entail the truth of the prejacent.

5. Sometimes the point of a modal assertion seems to be to proffer the prejacent as an answer to discourse-salient question and not on truth conditions.

3.2.2.1 A mechanism for Hearer evaluation of modal assertions

In this section I shall present the case for differentiating between objective and subjective utterances form the point of view of agreement and dissent to modal assertions. The following examples are discussed in (Portner, 2009, p. 149) and very similar ones also in (Papafragou, 2006).

(31)   a: Max must be lonely.   *(Subjective; based on Speaker's private knowledge)*

         b: That's not true. / I agree. / Are you sure?

(32)   a: The victim must have known the killer. *(Objective; based on publically available evidence)*

         b:That's not true. / I agree. / Are you sure?

In (Papafragou, 2006), the difference between (31a) and (32a) is suggested to be a matter of whether the modal base is solipsistic or intersubjective. According to her analysis, in response to a subjective modal assertion like (31a), the responses in (31b) can only target the prejacent. That is, Hearer would be agreeing, disagreeing or questioning that Max is lonely, perhaps with different levels of commitment than Speaker. Meanwhile, since (32a) is presumably based on publically available evidence, (32b) can target the modal content itself based on doubts concerning the publically-available evidence being used to justify it. Hearer could be agreeing that the publically-available evidence does indeed make the prejacent in Speaker's assertion possible/necessary. The publicly-available knowledge allows Speaker and Hearer to feel entitled to assert based on an intersubjective modal base.

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She claims that a subjective assertion like (31a) is indexical, causing the modal base to be solipsistic, while an objective one like (32b) is not indexical and thus has an intersubjective modal base. This begs the question of how Speaker can expect Hearer to understand which modal base he intends. Even in the case of (32a), Speaker is certain to have some private knowledge which only he possesses and it is perfectly plausible that some of it is related to his conclusion. At the same time, his knowledge does not magically increase by his intending an intersubjective modal base, so it is questionable that he would feel entitled to make an assertion based on Hearer's knowledge. Thus, the only merit we seem to get from an intersubjective modal base is a theoretical one: an explanation for why Hearer can disagree--if she takes the modal base of Speaker's assertion to be relative to her knowledge too, and can judge that the prejacent is not necessary according to her knowledge and will thus be in a position to object.

However, Hearer can also disagree with subjective modal assertions. Portner (2009) claims that even in the case of (31b), "I agree" seems to agree with the modal claim, though based on Hearer's own subjective analysis. This seems like a valid argument since, as intuition will reveal, Hearer can agree as in (31b) even in situations where she would not be prepared to make a non-modal assertion that Max is lonely. Portner says in reference to (31) and (32), "...it seems that both a meaning incorporating the epistemic modal (subjective or objective) and one not incorporating it can be targeted in conversation" (p.150). His use of "modal" instead of "the modal proposition" seems to indicate that he is assuming that Hearer is not necessarily objecting to the truth of Speaker's asserted proposition, but re-modalizing the prejacent according to her own knowledge.

If we must assume that agreement in (31b) can be based off of Hearer's own subjective utterance in any case, then what merit is there to say that (32b) is not? The only difference is the availability of publically-available evidence, i.e. evidence that both Speaker and Hearer possess and know that the other possesses, available or not. In this way, we might be able to characterize our intuition regarding objective and subjective modal assertions as reactions to the relation of the common ground with the modal assertion, i.e. whether the relevant evidence seems to be in the common ground.

Assuming that all Hearer evaluations are based off of her own subjective evaluation, the riddle we must solve is reduced to one: why Hearer would react to an assertion based off of Speaker's private knowledge. If we accept

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that subjective and objective modal assertions trigger Hearer evaluation through the same mechanism, we can use the same solution for both of them. In Portner's solution, an intersubjective modal base plays no role and in von Fintel & Gillies) solution, Hearer builds on Speaker's solipsistic modal base to gain doxastic access to a stronger intersubjective one. We shall examine these two proposals next.

3.2.2.2 Agreeing with the prejacent: Portner (2009)'s CPS

Portner (2009) suggests that in making an epistemic possibility utterance, Speaker both "asserts the possibility" of the prejacent, and suggests its inclusion in a "common propositional space" (CPS). CPS is distinct from the common ground in that it, "contains propositions to which participants are mutually interested but not fully committed" (Portner, 2009, p. 175). Portner's idea offers a way of formalizing the increase in saliency of the prejacent without requiring any participant to treat it as true, as would be required for its inclusion in the common ground.

This gives an answer to problem (1.); it explains why Hearer would agree or disagree with a modal assertion which was relative to a solipsistic modal base. Given this proposal, Hearer's agreement/disagreement in the subjective (31b) and the objective (32b) could both be described as her reassessment of the prejacent based on her own knowledge. The difference is that in this case of (32b) it is common ground that Speaker and Hearer share relevant knowledge (evidence from the crime scene) so their subjective assertions can be assumed to be based on similar premises.

Since this does not require an intersubjective modal base, it avoids having to assume that Speaker feels entitled to assert a modal proposition relative to a modal base whose contents (e.g. Hearer's knowledge) he cannot know, a problem pointed out in 3.1. In the case of objective assertions, it also allows Speaker's and Hearer's conclusions to differ based not just on errors in deduction based on publically-available evidence from the crime scene, but also on private facts they may know about the crime. For example, Hearer may disagree with Speaker because she knows more about the victim's everyday habits than Speaker. Disagreeing that Max was lonely would be essentially the same process, where Hearer knows something about Max that she believes Speaker does not.

However, by isolating the prejacent from the assertion, Portner has essentially reproduced the discourse effect

of a polar question. If this is what is responsible for Hearer's responding, then why do we interpret her response in modal terms? That is, we take her agreement not to mean that she is of the opinion that Max is lonely, not that she is of the opinion that the victim knew the killer but, to put it in informal terms, that there's a very good chance that Max is lonely or that the victim knew the killer. Since responses do not actually seem to target the truth or falsity of the prejacent, it seems the CPS must have some kind of additional "framing" to explain why reactions to it are interpreted in modal terms.

The CPS resembles how polar questions are modeled in the Stalnakerian discourse model developed in (Farkas & Bruce, 2009).[56] Farkas & Bruce point out that a "conversational crisis" occurs in the case of a negative reply to assertions but not to polar questions. They attribute this to Speaker committing himself to the truth of the uttered proposition in the case of assertions (their "commitment" corresponds to what I have called Level 2 acceptance where "Speaker believes p" is added to the common ground), but not in the case of polar questions.

For modal assertions, if the prejacent is added to a shared set of propositions to which the discourse participants are not fully committed, this would seem to predict that modal assertions should exert the same discourse effect with respect to their prejacents as polar questions do with respect to their proposition. Thus, if Speaker can be said to not have indicated any commitment to the prejacent by his utterance, the CPS may have some empirical validity and we might have reason to explain our interpretation of replies as not targeting the truth of the prejacent by some independent pragmatic stipulation. However, consider the following from (von Fintel & Gillies, 2011).

Alex is aiding Billy in the search for her keys.

(33)   a: (Alex=female) You might have left them in the car.

                        b: (Billy=male) You're right. Let me check.

                        b': (Billy) No, I still had them when we came into the house.

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[56] See also (Ginzburg, 1995) for more on questions under discussion (QUDs), similar to the question stack concept of Farkas & Bruce.

von Fintel & Gillies suggest that (33b') could be a reaction to the prejacent, but point out in a footnote that providing evidence for the rejection is almost obligatory. The discourse pressure on Hearer to provide evidence suggests that Hearer has interpreted Speaker as committing himself to the prejacent in some positive way, which diverges from the case of a polar question. This is not predicted by the CPS model as is.

In (31b) and (32b) we looked at examples of *must* and determined that Hearer's agreement is not that the prejacent is true, but that there's a very good chance that it is true. In (33b) as well, Hearer is certainly not agreeing that the keys are in the car, as her agreement does not relinquish her of the need to <u>check</u> to see whether they are indeed there or not. Rather, the assertion seems to <u>give her reason which she lacked before</u> on which to act and go check. Thus, whether agreeing or disagreeing, it seems that Hearer is reacting to some kind of commitment to the prejacent by Speaker. If we are to use the CPS to explain why Hearer reacts to a modal assertion whose truth conditions are relative to a solipsistic modal base, we need to suppose some kind of special status for the propositions in the CPS other than just an uncommitted question[57].

Since Hearer's response seems to be interpreted as a response to the modal assessment, even if it is subjective, it would seem more desirable to find a solution which does not require severing the prejacent from the modal assertion. Thus, the biggest hurdle before explanatory adequacy for the CPS can be worded as follows: If the object of public evaluation is a non-committal, non-modal proposition, how can Hearer "agree" to it? In practice, she seems to agree in terms of there being a good chance.

For objective assertions, supposing an intersubjective modal base allows the target of agreement to be modal. Since our goal is to account for all of Hearer's responses with the same mechanism, another strategy would be to suppose that all modal assertions are potentially relative to an intersubjective modal base. This is the strategy taken in (von Fintel & Gillies, 2011).

3.2.2.3 Agreeing with an intersubjective modal base-relative proposition: von Fintel & Gillies (2011)'s Cloud

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[57] This, I will show later, is exactly what a human possibility assertion means: it signals a commitment to the presence of positive evidence for the prejacent but a question regarding the prejacent's complement.

of Contexts Framework

von Fintel & Gillies (2011) give another account for why Hearer will agree or disagree with a seemingly subjective modal assertion. In their proposal, semantics leaves it to the utterance context to choose what knowledge is included in the modal base. However, the context is indeterminate--it will often allow more than one setting for the modal base, which could be the knowledge of Speaker, of Hearer, of Speaker & Hearer, or virtually any other individual or group of individuals. This is defined as a "cloud of contexts" C containing many determinate individual contexts c, wherein the setting for the modal base is fixed, in C. Whenever a bare epistemic modal is uttered, a cloud of contexts C is "floated," and Hearer must choose a particular context c in C with respect to which she evaluates Speaker's utterance. Speaker is only required to believe he is sufficiently justified in asserting based on one of the available modal bases.

Their framework does not predict any semantic differences which would affect how Hearer can respond based on the subjectivity or objectivity of a modal assertion. That is, whether or not an intersubjective modal base is available, whether Hearer interprets it relative to one is up to her, so the basic interpretation mechanism will be the same for any given modal utterance. This satisfies our preliminary goal of using one mechanism for all modal assertions.

Unlike Portner's CPS, it also allows Hearer to react to Speaker in terms of modality rather than the truth of the prejacent. When Hearer agrees, she is saying that the prejacent is possible relative to an intersubjective modal base. However, since Speaker is only required to be committed to one of the modal bases made available by the cloud of contexts, a condition which is automatically satisfied relative to the solipsistic one in any case an intersubjective one would also entail a true modal propositions, it runs into similar problems to the CPS in terms of agreement. That is, there is no situation which logically requires Speaker to commit to a proposition based on an intersubjective modal base. I will use (33) to demonstrate.

Billy is looking for his car keys.

(33)   a: (Alex=female) You might have left them in the car.

b: (Billy=male) You're right. Let me check.

b': (Billy) No, I still had them when we came into the house.

The truth conditions for Alex's utterance in (33) can depend on three bodies of knowledge depending on the context chosen: Alex's, Billy's, and the distributed knowledge of both. According to von Fintel & Gillies' proposal, Alex, in uttering (33a), 'floats' all three readings but only needs to be able to assert one of them for it to be felicitous; in this case Alex could minimally assert the solipsistic modal base-relevant proposition. The other two readings are posed as questions for Billy to answer for himself. Thus, if Billy were to rebut Alex's utterance based on his knowledge, he would be rebutting one of the three readings, but this leaves the reading asserted by Alex untouched because it is common knowledge that one person cannot know or dictate the knowledge of another.

von Fintel & Gillies depict the evaluation process as follows. Billy, upon hearing (33a), will know that the prejacent is not contradicted by Alex's knowledge. Let us assume that it is also compatible with Billy's knowledge. Now what of the third reading, where both of their knowledge is pooled? Since Billy does not know what Alex's knowledge is precisely, Billy cannot be sure that their pooled knowledge is also compatible with the keys being in the car[58]. However, the authors point out that in most cases it is reasonable to assume that if the knowledge of all discourse participants allow the possibility, their combined knowledge also does. They label this assumption, "defeasible closure."

Defeasible closure allows Billy to agree to the strongest floated proposition even though he doesn't know precisely what Alex's knowledge is. The point is that Billy is not agreeing with the or solipsistic (i.e. subjective), readings, i.e. agreeing that Alex believes the keys might be in the car or agreeing with Alex that he believes the keys might be in the car. He is stating that his knowledge with respect to the keys being in the car is compatible with Alex's knowledge. In the authors' framework, agreement by a person is licensed by that person's belief that the reading relative to the most exclusive body of knowledge to which they can reasonable have an opinion is true. But does this truly match what is happening

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[58] For instance, let's say it's 1pm and Alex and Billy just started looking for the keys. Alex could know that she tried to go to the store at 12pm but when she went to the car the keys weren't in it. Since it's now 1, the keys could have gotten in the car in the meantime. Billy may know that the last time he drove the car was at 11:00, and he hasn't seen the keys since then. Both independently allow the possibility that Billy's keys are in the car, but combined, since Alex has checked the car since Billy last used it, the keys can't be in there. However, given only (33), this knowledge is not shared.

on an intuitive level?

It is rather unintuitive that Billy would "agree" with a proposition that was not asserted but floated. If floating a proposition is like posing a polar question rather than making an assertion, as we observed in terms of the CPS, then Billy would be more apt to respond with "Yes, that's right." than "agree"[59]. Since Billy would be unlikely to believe that Alex's assertion is relative to a modal base relative only to his(Billy's) knowledge, Billy's agreement is either to an uncommitted proposition, i.e. the intersubjective one, or to a proposition which is relative to only Alex's knowledge, which would bring us back to where we started. As the authors point out, this framework also fails, like the CPS, to give a reason for the discourse pressure on Billy to justify her rejection in (33b) due to this same lack of positive commitment.

However, even given that the unintuitiveness of agreement with uncommitted propositions could be overcome by further plausible suppositions like conventionalization, this framework fails to account for several potential reactions which suggest the involvement of the common ground.

(repeated) (Alex=female) You might have left them in the car

(34)   (Billy) I hadn't thought of that. You're right.

(35)   (Billy) Hm, maybe. What makes you say that?

(36)   (Billy) You're right, but what made you say that?

If what Billy is doing is verifying that his own knowledge doesn't contradict p and then assuming via 'defeasible closure' that his knowledge and Alex's knowledge are jointly compatible with p, how could he know what Alex "thought of" in order to say (34)? Additionally, (34) and (35) both clearly indicate acknowledgment that both participants' individual bodies of knowledge are compatible with the prejacent, but in (35) Billy seems to expect Alex to have some piece of knowledge which he does not, not just a lack of contradictory knowledge. In (36), what could make Billy question the

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[59] Consider the following: "Nothing contradicts the keys being in the car according to my knowledge. Might the keys be in the car according to your knowledge, too?" -- #"I agree." / "Yes, that's right."

basis for Alex's modal assertion even though he agrees with its conclusion? If Billy can agree while maintaining that her knowledge is different, it seems he is not utilizing defeasible closure so, minimally, a floated proposition which is relative to an intersubjective modal base cannot be the object available for Hearer to agree to.

The cloud of contexts framework does everything in terms of the modal base, so it provides no way to factor in a body of knowledge which only includes common knowledge and not private knowledge. In addition to presenting difficulties for (34) to (36), this makes for difficulty in accounting for the intuitive difference between (31a = Max must be lonely.) and (32a=The victim must have known the killer.) without supposing some kind of linguistic marker for solipsistic or intersubjective modal bases, as Papafragou (2006) does with indexicality.

Using their framework, when (31a = Max must be lonely.) and (32b=The victim must have known the killer.) are asserted, Speaker could intend a solipsistic modal base or an intersubjective one. As long as he believes he has sufficient justification for asserting one of them, he can make the assertion. Hearer will then know that Speaker believes the proposition is true at least relative to a solipsistic modal base. She can then evaluate whether it is true relative to her own solipsistic modal base. If it is, she can agree based on an intersubjective modal base. The prejacent then becomes a necessity relative to an intersubjective modal base including Hearer and Speaker's knowledge in the common ground. But given this process, what is the point of there being publically-available information?

In their framework, the informational contribution of this exchange comes from the belief that neither Speaker nor Hearer's knowledge contradicts the prejacent (i.e. that the modal proposition is true relative to an intersubjective modal base). Given this, any knowledge which is already common ground, such as evidence at the crime scene, would be irrelevant to the informational content of the assertion as they would already know an intersubjective modal base would be true if this were the only related information in it. Since intuitively there is an informational contribution made by and expected of objective modal assertions, it seems that Speaker assumes in both objective and subjective assertions that he has knowledge which Hearer does not.

3.2.2.4 Necessary characteristics for an adequate mechanism for agreement and disagreement

Over the past two sections, we first observed that Hearer can agree with Speaker in the case of both objective

and subjective modal assertions, but that in the case of the first she seemed to challenge his modal claim and in the second she seemed to be reevaluating the prejacent based on her own subjective analysis. We then concluded that if Hearer can agree/disagree with either type of modal assertion, it would be more theoretically desirable to account for both with the same mechanism.

We first considered the CPS (Portner, 2009). It provided a common object for Hearer to react to, and we supposed that the fact that is common territory allows it to be considered in relation to the common ground. From here we might suppose that agreement to objective modal assertions seems to be more objective because there is more relevant information in the common ground allowing for more closely corresponding conclusions. However, it failed to account for why we interpret Hearer's responses to be modal instead of in terms of truth. It also failed to account for why there would be pressure on Hearer to justify disagreement.

We then considered the cloud of contexts (von Fintel & Gillies, 2011). Unlike the CPS, it does portray Hearer's agreement as addressing a modal proposition. However, it had to assume a new definition for agreement in which it can occur with respect to non-committed propositions. This also implies that disagreement is with respect to a non-committed proposition which, in contrast to empirical fact, would suggest a lack of discourse pressure on Hearer to justify her disagreement. This weakening of assertion also resulted in the explanatory power of intersubjective modal bases for the intuitive difference of objective utterances. If Speaker only has to commit to the solipsistic modal base, the only way to account for believing Speaker feels entitled to assert based on an intersubjective one is the common ground. It also failed to account for agreement which maintains that Speaker and Hearer have different information which is related to the modal assessment.

It seems that an intersubjective modal base does not provide a viable way of account for agreement and disagreement facts. Severing the prejacent from the modal assertion also does not provide a viable account. Given the strong and weak points of both proposals, I suggest an adequate mechanism for agreement/dissent to modal assertions requires the following characteristics:

● Makes a proposal to the common ground with which Hearer can agree and disagree

- Entails a positive commitment by Speaker, so that:

  ➢ Hearer has something to agree with rather than just affirm

  ➢ There is a reason for there to be discourse pressure on Hearer to justify herself if she makes a negative response.

- Is general enough to apply to both objective and subjective instances of modal assertions

  ➢ Allows Speaker and Hearer to agree while maintaining that they have different reasons for agreeing with whatever they are agreeing with

  ➢ Also allows Hearer to agree with Speaker when there is ostensibly related evidence in the common ground.

3.2.2.5 Embedding modals under factive predicates

I am proposing that an intersubjective modal base does not work as an explanation for agreement and dissent to modal assertions. If we accept that only solipsistic modal bases are necessary, we will have to find another way to explain the other facts which are used as support for a linguistic difference in how the content of a modal base is determined. This brings us to modals embedded under factual predicates.

(37) ?It is surprising that Superman must be jealous of Lois.   (subjective reading)

(38) It is surprising that the victim must have known the killer.   (objective reading)

In the above readings, Papafragou suggests that "subjective" modals are actually indexical, and thus are relative to Speaker's knowledge only, while objective modals are not indexical and can thus pick up the knowledge of a larger group. Since an indexical modal is bound to Speaker's knowledge only (or so Papafragou is asserting), it is inscrutable to Hearer. This makes it unsuitable to be embedded under a factive predicate, which requires its complement to be factual. When the modal base is intersubjective, the modal proposition can be so embedded. But if being intersubjective implies that a modal proposition is fact, then why would it ever be asserted?

Papafragou's analysis relies on a somewhat opaque intuitive grasp of which expressions should be indexical and which not, and offers no explanation of what factors determine whether a given modal expression is indexical or not. Is it induced by syntax? Is it induced by a context? Making her proposal explicit coincides with finding an explanation for the variable truth judgments people have for possibility and, to a lesser extent, necessity modals that we saw in the last section.

It seems the first thing we require an explanation of what it means for a modal proposition to be a "fact" and why a subjective one cannot be one. In common ground discourse models, propositions which are common ground are considered facts for the purpose of the discourse. Given this, we can reframe the question in this way: assuming both (37) and (38) have not been previously asserted in the current discourse event, why can (38) can be accepted as common ground while (37) cannot?

Given the above, it seems premature to conclude that the infelicity of embedding subjective modal propositions is due to the modal base needing to be solipsistic. Instead, it may have to do with more general pragmatic principles. Thus, an adequate explanation of embedding facts will also require determining what modal assertions add to the common ground, and when whatever they add can be considered fact. I will give such a proposal in 3.5.2.3.

3.2.2.6 Proffering the prejacent as an answer to a question

One of the early motivations for proposing a separate subjective type of epistemic modality was to account for their function as speech act indicates. In the last few sections the object of investigation was, based on the responses that Hearer can make, addressing the question of what the nature is of what she is responding to after hearing a modal assertion. In this sub-section, we will focus instead on a performative aspect christened as "proffering" which appears in some environments.

In the functional and descriptive literature, the general assumption is that all epistemic modals are subjective and closer to function words rather than to content words. Though certainly not the first or last claim of this nature, Halliday (1970, p. 349) wrote that modality is "external to the content [of the sentence]" and reflects the "attitude taken up by the speaker." This is a reflection of the intuition that a modal assertion somehow brings the status of the prejacent to the discourse floor, and that Hearer cannot straightforwardly say that Speaker's "attitude"

(necessity/possibility) is false. This could put them in the same class as parenthetical hedges such as " […], I think." which are said not to affect the truth conditions of the utterance, or at least of the "main point" of the utterance[60]. However, von Fintel & Gillies (2007) point out that embedded modal sentences do contribute to truth conditions and so they cannot be brushed off as parentheticals. They offer (39) as proof.

(39) If there might have been a mistake, the editor will have to reread the manuscript.

In (39), the modal clause in the antecedent is not being asserted and does not perform any speech acts, but it does contribute to the truth conditions in a way distinct from a sentence in which only the bare prejacent was embedded would. Thus, a claim that modality is completely external to the content of an utterance seems untenable. Nevertheless, it is a fact that modals can function in a similar fashion to parentheticals; they often raise the possibility of the prejacent as an answer to some relevant discourse question.

For instance, in (von Fintel & Gillies, 2007), it is suggested that in the case of bare modal assertions (i.e. modal assertions without prepositional restrictors like "according to" and "in view of"), in addition to asserting the truth conditions, they "proffer" the prejacent. Consider the following, also from (von Fintel & Gillies, 2007).

(40)   Q: Why isn't Louise coming to our meetings these days?

          A: She might/must be too busy with her dissertation.

In this case, Speaker seems to be asserting that "Louise is too busy with her dissertation" could be the answer to the question. The fact that it is possible that Louise is busy, which should constitute the semantic content of the utterance, seems to be taken for granted, or backgrounded. A general tendency of the truth conditional content of

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[60] If embedded in a conditional, a parenthetical does not contribute to truth conditions. For example, in "If there's a mistake, as I think there is, then the editor will have to reread the manuscript," whether or not Speaker thinks there is a mistake is not part of the condition under which the editor has to reread the manuscript, and so "as I think there is" is not considered to contribute to the truth conditions of the utterance.

modal expressions to seem backgrounded with respect to the prejacent has led some to suggest a dichotomy in epistemic modals, where some modal expressions (objective ones) have truth conditional content and some do not. Thus, another factor for splitting modals into objective and subjective was to account for instances of modal assertions where the point seemed to be to show Speaker's degree of confidence in the prejacent as an answer, while the truth conditions, taken to indicate whether the prejacent is contextually possible or not, seem to be irrelevant.

The objective-subjective dichotomy was christened by Lyons. Lyons suggests that what he calls subjective modals serve as speech act markers, indicating Speaker's degree of commitment to the prejacent, while what he calls objective modals contribute truth conditions. This could potentially explain the observations in (39) and (40). Since the modal proposition in (39) is embedded, it clearly contributes to the matrix proposition's truth conditions. Thus, we can assume that the modal is relative to what are presumably objectively-available facts and is thus an objective modal with semantic content. Meanwhile, since the issue of whether the prejacent is possible seems backgrounded in (40), we can assume that the modal is relative to Speaker's private knowledge and thus intended as a speech act marker indicating that Speaker isn't fully confident in the prejacent as an answer.

However, it seems premature to conclude that normal assertion of *might/must* cannot result in proffering effect. Again we are neglecting the fact that once a question has been asked, the proposition which was presupposed by it is common ground and thus known to be included in Speaker's modal base. Granted, if all Speaker is saying is that the prejacent is not impossible given that "Louise is not coming to meetings" it would not provide an explanation for why the prejacent seems to be proffered as an answer to the question. After all, almost any proposition would be true if embedded under *might* if this were the truth conditions. However, as we have seen over the past few sections, there seems to be a positive commitment by Speaker entailed by any assertion of an epistemic modal proposition. Until we identify what that is, it is premature to say that the proffering effect is distinct from standard assertion.

3.2.3 Section conclusion

In this section we reviewed the literature on epistemic modals from two perspectives. First we looked at how to determine truth conditions for given utterances. We saw that while Speaker's knowledge does seem to be involved,

sometimes the truth conditions seem to be stricter than they would be based on only a solipsistic modal base. Intersubjective modal bases were introduced as a potential solution, but they suffered several explanatory inadequacies:

- Why Speaker will sometimes assert that he does not knowing if a proposition is possible and sometimes will not.

- Why an epistemic possibility assertion which would be false given a correction of Speaker's mistaken deductions based on a ship log are always judged as false while a possibility assertion which would be false given the content of an unopened letter are not.

- Why Speaker would ever feel entitled to assert based on a modal base which includes Hearer's knowledge.

- Why information contributed by an eavesdropper can cause Speaker to admit he was wrong even though the eavesdropper's knowledge cannot be considered to be contained in the modal base.

Second, we reviewed the literature from the perspective of Hearer interpretation, focusing on agreement and disagreement. The principle question was, if Speaker's assertion is based on a solipsistic modal base, with what could Hearer be agreeing or disagreeing? Intersubjective modal bases were proposed as a way to account for Hearer's reactions to objective modal utterances, but could not explain Hearer's reactions to subjective modal utterances because Hearer would not know what knowledge the assertion is based on.

I proposed that since Hearer can react to both types of utterances, a single mechanism which can account for both while also predicting that they feel different intuitively is necessary. I reviewed two proposals for explaining agreement and disagreement to subjective assertions, showing that they can both be applied to objective utterances as well. However, they both failed to account for a positive commitment by Speaker in modal assertions, and for the ability of Speaker and Hearer to agree on a modal proposition while maintaining that they have distinct knowledge which is relative to the modal assertion. Neither provided a suitable object for Hearer to target in agreement and disagreement.

We also reviewed the fact that subjective modal assertions cannot usually be felicitously embedded under factive predicates. Since objective utterances can be embedded, it follows that objective modal propositions can be common ground. Here we concluded that before determining that a linguistic explanation is necessary, we have to determine what it means for a modal proposition to be "fact" and what about an objective modal assertion allows it to be considered a fact even if it hasn't been asserted.

I propose that all of these problems result from a failure to actively consider the role of the common ground in production (i.e. truth conditions) and interpretation. In the next section, I will show that interpreting modal assertions as proposals to update the common ground can explain all of these issues without having to assume an intersubjective modal base. The truth conditions are affected by the common ground, as is interpretation.

3.3 Updating the common ground with modal assertions

Many works in the literature assume that modal propositions make some kind of informational contribution, whether that be to the common ground or some other theoretical construction. However, in trying to discern what that contribution is, they assume that its semantic aspect is fixed by the truth conditions of the utterance, and thus try to determine a fixed modal base based on some individual or group's knowledge before considering the quantity demand made by the discourse at the time of utterance (cf. Papafragou, 2006; Portner, 2009; von Fintel & Gillies, 2011). This dissertation assumes that the quantity maxim is just as basic as the quality maxim and so, when analyzing a discourse-embedded utterance, since it is constricted by the quantity demand, determining whether it can be true or not before determining how it can be informative will not allow an accurate portrayal of the utterance.

In the case of a non-modal assertion, its propositional content does not change based on context, so its informational potential <u>is</u> determined by the truth conditions[61] making quantity considerations seem secondary. Such an assertion is a proposal to add the asserted proposition to the common ground, and if it is already there, the assertion is infelicitous, violating quantity. However, for possibility assertions, since the minimal truth conditions

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[61] Of course the conversational implicatures it allows will vary according to the discourse, but these hinge at least partially on the propositional content.

only require Speaker to <u>lack</u> knowledge, we end up with Speaker asserting that his knowledge entails something that is already in the common ground: that the prejacent is contextually possible[62]. This does not require that any other discourse participant change their beliefs with respect to the prejacent or its possibility, and thus does not constitute an informational contribution. Given these semantics, what can Level 0 acceptance for modal assertions, i.e. acceptance which brings first-order belief change relative to the prejacent to the common ground, be?

Since non-modals indicate the truth or falsity of a proposition and modal assertions indicate (or more precisely, constrain) the possibility configuration of a proposition, the obvious assumption to make is that modal assertions are proposals to update the possibility configuration of the prejacent with respect to the context set. This is why possibility assertions are not just confirmations of contextual possibility, as I suggested at the outset of this chapter. This is what produces the "not-quite-truth" commitment made by Speaker which could not be identified in 3.2. This is why the prejacent seems to be "proffered," as we saw in 3.2.2.6. This is why Hearer can take action based on a possibility assertion, as we saw in 3.2.2.3. This is why Hearer will argue with Speaker despite the propositional content being relative to Speaker knowledge, as we saw in 3.2.2.1-4, and this is why Speaker will sometimes say *I don't know* and sometimes will not, even with the same knowledge available to him, as we saw in 3.2.1.

However, for a modal assertion to upgrade the possibility configuration relative to the context set, we have three theoretical issues we must address.

6. In general, what is required for the possibility configuration of a given proposition *p* relative to a set of propositions *P* and a set of *P*-accessible worlds to change?

7. How can the possibility configuration of a proposition relative to a Speaker-based set of epistemically accessible worlds translate to a possibility configuration relative to a common context set?

8. Why and how can Hearer know that Speaker is trying to update the possibility configuration of the prejacent with respect to the context set even though the uttered proposition only denotes a relation between the prejacent

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[62] Granted, if Hearer viewed Speaker as being an expert on whatever the prejacent is, for instance a meteorologist predicting rain, even a lack of knowledge reading may be informative, but this is hardly a requirement. In most cases, Speaker and Hearer are on similar epistemic grounds so simply confirming that one another cannot rule out a proposition will not result in real change.

and Speaker's epistemically accessible worlds and stereotypical max set?

3.3.1 The formal requirements for updating the possibility configuration of a given proposition

This section addresses the first issue. We are assuming doubly-relative possibility for *must* and *may*, but to simplify exposition we will work with singly-relative operators in this section, and relate the results to our doubly-relative operators after. We shall work with a generic set of P-accessible worlds X such that X is the intersection of a given set of propositions P. If P contains a proposition q, then X will only include q-worlds and no $\neg q$ worlds. We shall take a dynamic approach, and assume that P starts off as the empty set and can be updated with new propositions to shrink X. Our objective is to determine what has to be added to P in order to update the possibility configuration of any proposition p with respect to X.

As we saw in 2.1.2, modal operators can be used to partially indicate the possibility configuration of a proposition. We typically distinguish two types of modal operators: necessity operators and possibility operators. In a singly-relative modal framework, possibility operators but not necessity operators underdetermine the possibility configuration.

In maximally general terms, possibility is defined in terms modal operators quantify over two sets of worlds (i.e. two propositions), one the set of worlds compatible with the prejacent p and the other the set of worlds X determined by the modal base (and for Kratzer the ordering source as well). Given these two propositional arguments X and p, modal operators indicate whether p and X have at least one possible world in common (p is a possibility), whether p includes all X-worlds (p is a necessity), or whether p and X have no worlds in common (p is an impossibility). Restated in function terms, they indicate whether the two propositions are both true at any given world (possibility), whether one is true at all the worlds the other is (necessity), or whether they are not true at any of the same worlds (impossibility). From these relations, we can find 3 possible configurations for any given proposition p and its complement $\neg p$ (see also **Table 1**, p 44).

(Ambiguous between Configuration 1 & 3) p is possible w.r.t. to X, there is <u>at least one</u> p-world in X .

(Configuration 1) p is necessary w.r.t. to X, so <u>all</u> X-worlds are p-worlds.

- ➢ Since if all X-worlds are p-worlds there is at least one p-world in X[63], necessity of p w.r.t. X entails that p is also possible w.r.t. X.

- ➢ Necessity of p w.r.t. X entails that $\neg p$ is impossible w.r.t X.

(Configuration 2) If a proposition p is impossible w.r.t. to X, so <u>all</u> worlds in X are $\neg p$-worlds.

- ➢ Impossibility of p w.r.t. X entails that $\neg p$ is necessary w.r.t X.

(Configuration 3) If p is possible but not necessary w.r.t. X, so there is at least one p-world and one non p-world, making both p and so $\neg p$ possible, and similarly for $\neg p$.

Since P starts off as empty, X is at first equivalent to W, the set of all possible worlds. As such, every non-contradictory proposition is possible[64] and no proposition except for those expressing logical truths and universal truths such as mathematical truths will be necessary with respect to X. Thus, taking p to not be a logical or universal truth, p is possible and so is $\neg p$ *so* we start with Configuration 3. There are two ways we can change this configuration: change X so as to make p necessary (Configuration 3 -> 1) or change it so as to make p impossible (Configuration 3 -> 2).

The most obvious way to update the possibility configuration of p w.r.t. X is to add p or $\neg p$ to P. This would cause X to include only p-worlds or only $\neg p$-worlds, making one of them necessary and one of them impossible. However, this is what a non-modal assertion does and we want to know how a modal assertion can update the possibility status of p w.r.t. X. Since modals are typically used when it is assumed that the absolute truth value is not currently known, we need to update X without directly adding p or $\neg p$ to P.

Since P is empty, X includes every possible world, i.e. $X = W$. W can also be expressed as the union of any given proposition and its complement. That is, as a general rule, $p \cup \neg p = W$, and so when P is empty X is equivalent

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[63] Presupposing that that X is not empty
[64] For example, "p and $\neg p$" would be contradictory and thus impossible wr.t. W.

to $p \cup \neg p$ for any proposition p. This complementary division is recursive, and so each complement can be divided w.r.t. a second proposition and its complement in the same way. For example, for propositions p and q, we can say $(p \cap q) \cup (p \cap \neg q) = p$ and $(\neg p \cap q) \cup (\neg p \cap \neg q) = \neg p$. Naturally, the reverse also holds.

If we add a proposition q to P, this means that X is restricted to not include $\neg q$ worlds. Let's see how adding q to P, i.e. subtracting $\neg q$-worlds from X, affects the possibility configuration of a logically independent proposition p.

$p \cup \neg p = X$

$\quad (p \cap q) \cup (p \cap \neg q) = p$

$\quad (\neg p \cap q) \cup (\neg p \cap \neg q) = \neg p$

$X - \neg q$

$= (p - \neg q) \cup (\neg p - \neg q)$

$= (p \cap q) \cup (\neg p \cap q)$

Although the end set is smaller, the possibility configuration of p is still Configuration 3. The new subset has both p-worlds and $\neg p$ worlds. This calculation may have seemed pedantic, but it is intended to make the point that, unless there is some proposition which logically links q to p in P, proposition q cannot affect the possibility configuration of p w.r.t. X.

In contrast to the case just considered, if our set of worlds X is restricted by a proposition in which q is logically connected to either p or $\neg p$, then the possibility configuration of p can be changed by the removal of $\neg q$. One type of proposition that does this is conditionals. For instance, if the set of worlds is restricted by $q \rightarrow \neg p$, we get very different results when we subtract $\neg q$.

Again, we start with X and an empty set of propositions P. First we add $q \rightarrow \neg p$ to P. By material implication, conditionals exclude all and only those worlds where the antecedent is true and the consequent is false. Thus, we must subtract worlds where p and q are both true from X.

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X

$= p \cup \neg p$

Restrict with conditional:

$(p \cup \neg p) \cap (q \rightarrow \neg p)$

$= (p \cap (q \rightarrow \neg p)) \cup (\neg p \cap (q \rightarrow \neg p))$

$= (p\text{-}q) \cup \neg p$

$= (p \cap \neg q) \cup \neg p$

Having the conditional proposition as a restrictor subtracts a subset of *p*-worlds, but no ¬*p*-worlds. *p* and ¬*p* both remain possible w.r.t. *X*, but there is now a clear avenue to change the possibility configuration of *p*: add *q* to *P*, subtracting ¬*q* worlds and thus making *p* impossible and ¬*p* necessary (Configuration 3 -> 2).

$((p \cap \neg q)\text{-}\neg q) \cup (\neg p\text{-}\neg q) = X$

$= \varnothing \cup (\neg p \cap q)$

$= \neg p \cap q$

This time we end up with a set that only includes worlds where ¬*p* and *q* are true. ¬*p* is a necessity and *p* is impossible. The possibility configuration of ¬*p* relative to *X* has changed from Configuration 3 to Configuration 2 by means of adding ¬*q* to *P*. Our objective was to know what has to be added to *P* in order to update the possibility configuration of any proposition *p* with respect to *X*. One answer: a linking material conditional proposition with ¬*p* or *p* in the consequent and some other proposition *q* in the antecedent together with the proposition *q*.

This answer applies uniformly to human modality. Generally, the modal base and ordering source serve to restrict a subset of *W* to two discourse-relevant subsets, $\cap f$ and $max_g(\cap f)$. For a given proposition *p* to have a different possibility configuration than what I labeled as Configuration 3 above relative to either of these sets, the

modal base *f* and/or the ordering source *g* must contain some proposition which is logically linked to *p* or its complement. This general need for a logical link can be expressed by a conditional, so we can say that if either the modal base or the ordering source contain a conditional whose consequent is the prejacent or its complement, the possibility configuration of the prejacent can be changed by adding the antecedent to the modal base or the ordering source.

All conditionals which are logically connected to the prejacent are potentially significant in determining the possibility configuration of the prejacent because they restrict either the prejacent or its complement relative to an antecedent condition. Nevertheless, they do not themselves change the possibility configuration of the prejacent from what it is in $\cap f$ or $max_g(\cap f)$. To effect a change in the possibility configuration, the antecedent of a conditional restriction needs to be included in the modal base (or ordering source). Then the relevant set (be it $\cap f$ or $max_g(\cap f)$) will include only worlds where the consequent, i.e. the prejacent or its complement, is true.

One possibility, which in practice is the most common, and will be the main of focus in the remainder of this dissertation, is where neither the OS nor the MB alone is sufficient to restrict the possibility configuration (perhaps one contains q $\rightarrow$ ¬p and the other contains q) but together they do. Interlinking across MB and OS isn't formally required, but sufficient interlinking can change the possibility configuration.

For a linking proposition $o\rightarrow n$ in the modal base or the ordering source, ceteris paribus, if *o* is not in the modal base or the ordering source, *n*-worlds and ¬*n*-worlds will both be in $max_g(\cap f)$ (which entails being in $\cap f$). If we also have a second linking proposition $p\rightarrow q$ in the modal base or the ordering source, and *p* is in the modal base, then *q*-worlds will be in $max_g(\cap f)$ but ¬*q*-worlds will not be in $max_g(\cap f)$ or, in the case that the linking proposition was in the modal base, in $\cap f$. Therefore, adding *p* to the modal base changes *q's* possibility configuration. From these observations, we can classify linking propositions as active and inactive depending on the status of their antecedents.

Def. 22   Active Linking Proposition

For any modal utterance *modal p* interpreted relative to a modal base *f* and an ordering source *g* at a world-time pair *i*, if there is a conditional proposition ($o\rightarrow$n) in *g* or *f*, and either *g* or *f* entails *o*, $o\rightarrow$n is an active

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linking proposition relative to the possibility configuration of *p* at *i*.

Def. 23 Inactive Linking Proposition

> For any modal utterance *modal p* relative to a modal base *f* and an ordering source *g* at a world-time pair *i*, if there is a conditional proposition (o➔n*)* in *g* or *f*, and neither *f* nor *g* entails *o*, o➔n is an inactive linking proposition relative to the possibility configuration of *p* at *i*.

Only active linking propositions will restrict $max_g(\cap f)$ or $\cap f$ so that *p*-worlds or ¬*p*-worlds are excluded. Even so, inactive linking propositions do still have a role in determining what worlds are included in $max_g(\cap f)$ and $\cap f$. Consider the following *f, g* pair.

f = {p}

g = {a, b} where a= o➔n and b= p➔¬n

- Since *p* is in the modal base, the only *f*-accessible worlds where (b) is true are ¬*n*-worlds.
- Since *o* is not in the modal base, there are accessible worlds where *o* is true and accessible worlds where ¬*o is true.*
- Among the *f*-accessible worlds, (a) and (b) are not both true at *o, ¬n* worlds, ¬*o,n* worlds, or at *o,n* worlds, but they are both true at ¬*o, ¬n*-worlds
- Since both ordering source propositions are only true at ¬*o*¬*n*-worlds, only these worlds will end up in the max set $max_g(\cap f)$.

Note that we get the same max in both of the case neither ¬*o* nor *o* is in *f*, as above, and where ¬*o* is in *f*. This is because there are *f*-accessible worlds where the linking proposition *o*➔*n* and its consequent *n* is true in both cases. If we "activate" the linking proposition by putting *o* in *f*, we get a different max set. In this case, since there are no *f*-accessible worlds where both linking propositions (a) and (b) are true, by the partiality of the ordering function, the

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two subsets of the set of f-accessible worlds whether either (a) or (b) is true are put in the max set. I am labeling linking propositions as "active" or "inactive," but of course their logical properties are constant. "Active" is intended to capture the dynamic process wherein different bits of knowledge (formally, propositions) interact with other bits of knowledge.

When a linking proposition is in the modal base, it restricts the set of accessible worlds (and hence also the max set) while when it is in the ordering source it only restricts the max set. In either case, in practice, what brings about change, or "activates" the linking proposition is the addition of its antecedent to the modal base[65]. If the modal base has a linking proposition in it, then adding its antecedent to the modal base will result in its consequent being contextually necessary. If the ordering source has a linking proposition in it, then adding the antecedent to the modal base will result in the consequent being a human possibility or, if there are no disconnected branches of ranked worlds (see p. 68), a human necessity.

In human modality, stereotypical ordering source propositions typically serve as logical links between the modal base and the prejacent. When the modal base includes certain propositions, a linking proposition in the ordering source will be 'active,' restricting the max set such that the prejacent or its complement is absent. Since discourse is a process of information change and contextual change, 'activating' and 'deactivating' OS propositions can bring about changes to a proposition's possibility configuration.

Given this outline of what is necessary to change the possibility configuration of a given proposition, and supposing that the role of modal assertions is to update the possibility configuration of the prejacent, Speaker and Hearer will be able to make meaningful and systematic assumptions about what Speaker would have to know to felicitously assert a human possibility. In short, Speaker would have to know some proposition which activates a linking proposition in order to make a felicitous modal assertion[66].

The next section presents pragmatic presuppositions and accommodation as the vehicles by which Speaker's

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[65] Adding an antecedent to the ordering source would also activate a linking proposition, but since a stereotypical ordering source is a set of propositions which represent generalizations of accumulated experience, it does not typically change during a single discourse event.

[66] I have limited my attention to conditionals as linking propositions, partly because they are effective for representing a stereotypical ordering source for the independent reasons highlighted in Chapter 2, but the logic covered here remains as long as the linking proposition is logically connected to the activating proposition in an appropriate way.

knowledge that there is an active linking proposition could serve to activate the linking proposition in the common ground.

3.3.2 Pragmatic presuppositions and accommodation

Typical assertions try to fill in discrepancies among participants about what propositions they believe. In such cases, Speaker has a belief that he thinks should be in the common ground which is not because (he believes that) one, some or all of the other participants do not believe it, and so he asserts it by means of uttering it. However, there can also be discrepancies in what propositions participants believe to be, or at least treat as being, already in the common ground. Catching cues that imply or entail such discrepancies and making adjustments to eliminate the discrepancies is another way of updating the common ground. I propose that modal assertions make use of this mechanism to enact proposals for 1st-order belief change to the common ground.

Any proposition which a participant treats as common ground, whether or not they believe it is truly common ground or even that it is really true, is called a <u>pragmatic presupposition</u>.

A speaker presupposes that *P* at a given moment in a conversation just in case he is disposed to act, in his linguistic behavior, as if he takes the truth of *P* for granted, and as if he assumes that his audience recognizes that he is doing so. (Stalnaker, 1973, p. 448)

As the definition shows, a participant can mistakenly believe a proposition is common ground or choose linguistic expressions which depend on it as if it were common ground even knowing that it is not. Thus, for each such individually-determined set of presuppositions, we can derive an individually-determined context set, a set of worlds which will be a subset of the common context set.

Let us return to John and his belief that it is raining that we saw in 3.1. In this case, John is pragmatically presupposing that it is raining so his individual context set excludes possible worlds where it is not raining, but,

continuing with our original assumptions, the context sets of the other researchers contain both raining and not raining worlds. Now imagine that he utters (41).

(41) We should bring our umbrellas when we leave.

In (41), John recommends to his fellow researchers that they bring umbrellas. His recommendation is dependent on the belief that it is raining. As we said, John may not believe that *it is raining* is common ground, but since he made an utterance which depended on its truth to be appropriate and assumed that the other researchers would recognize this and accept it, we can say that he has treated it as if it were. He is pragmatically presupposing it.

In the case of (41), the other participants will know that John is recommending that they bring an umbrella based on the sentence meaning, but there is no common belief which merits this recommendation. As such, they must either deem John to have given a contextually inappropriate recommendation or somehow adjust their beliefs to accommodate his utterance, by adopting *it is raining* as a 1st-order belief or, if they are dubious of John's credibility, by adopting the second-order belief *John believes that it is raining*. In the first case, they will likely be motivated to bring their umbrellas. In the second, they are likely to reject John's recommendation.

This shows that a common set of beliefs is required to make sense of some utterances, and that this set can be updated by participants to maintain discourse coherence if the required beliefs are not shared prior to the utterance. This process of adding to the common ground beliefs that are required in order to make sense of Speaker's utterance is called accommodation, first proposed in a formal framework by David Lewis as follows.

If at time *t* something is said that requires presupposition *P* to be acceptable, and if *P* is not presupposed just before *t*, then - *ceteris paribus* and within certain limits - presupposition *P* comes into existence at *t*. (Lewis, 1979, p. 340)

The true common ground includes propositions all participants will take for granted in making utterances, but the set of propositions that each participant presupposes individually will almost always be larger than the common ground. The other participants must watch out for discrepancies between their presuppositions and those of the others, and accommodate where necessary and acceptable to them. In (41), John presupposed *it is raining* and the others had to realize that he was presupposing this and evaluate whether to add it to their own beliefs or not. John felt this was an acceptable move to make even though he knew the common ground didn't include *it's raining* because he believed that upon his utterance, the others would realize that *it's raining* is a required belief to make his recommendation acceptable and would adopt it as a 1st-order belief, independent of whether they accepted his recommendation (i.e., his asserted proposition).

If the researchers do not adopt this belief as their own, John's assumption has proved unfounded, but as long as they understand that he is presupposing it they can still interpret his utterance as they will always accept it as a second-order belief, i.e. as a belief of John's[67]. If they fail to realize *it's raining* is a necessary accommodation to interpret the utterance, or accommodate some proposition which John hadn't intended, communication breakdown may occur. In this way, accommodation of a presupposition is only possible when Hearer is able to realize that a presupposition is being made.

Above we saw an example of assertion which relies on Hearer inferring a situation-specific presupposition and accommodating it. However, there are also presuppositions which are systematically triggered by linguistic form. Possessive pronouns are an archetypical example of this. I will compare these to modal assertions, and show that they both systemically trigger accommodation thanks to the same conversational principles. Below, (43) is the pragmatic presupposition[68] and (42) is the assertion.

(42) I fed my cat.

(43) I have a cat.

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[67] This is conceptually similar to what is often called local (as opposed to global) accommodation (cf. Heim, 1988).
[68] In this case, it is also a semantic presupposition. I do not require the concept of semantic presupposition for this dissertation and so I will not make further reference to it.

For Speaker to assert (42) appropriately, he must believe it is true and, thus, he must believe that he has a cat and that he has fed it, though he only seems to be asserting the latter. Hearer, who will also assume by common belief in the quality maxim that Speaker believes what he asserts is true, will believe that Speaker believes everything necessary to make his proposition true. Although (43) is not what is being asserted, that is, it is backgrounded, Hearer must evaluate it anyway. In the case that Hearer does not already believe (43), she must decide whether or not to add it to her beliefs. Speaker knows Hearer will do this, and since it is typically common ground that a person believing they have a cat is sufficient reason for another person to believe it as well, he will assume that she will accept it and go on to evaluate his assertion in (42) based on the belief that it is true.

We account for Level 0 acceptance of modal assertions using this same quality-maxim-dependent mechanism, but combine it with the quantity maxim. In particular, I propose that for bare modal assertions (i.e. modal assertions without a qualifier such as "according to"), Level 0 acceptance amounts to accepting pragmatic presuppositions that must hold in order for the asserted modal proposition to satisfy the quantity and quality maxims.

The propositions in an epistemic modal base are not necessarily presupposed to be common ground, but they are believed by Speaker to be true of the actual world. Since Hearer believes Speaker is intending to be truthful and informative, and that he believes his modal base entails an update for the common ground, she will be impelled, in the same way as with any other salient pragmatic presupposition, to evaluate whether to admit his pragmatic presuppositions into the common ground.

In the next section, we will see how an individually-based epistemic modal base can produce pragmatic presuppositions for a socially-based common ground.

3.3.3 Epistemically-accessible worlds vs. the context set

This section will addresses the third theoretical issue raised at the outset of section 3.3: How can the possibility configuration of a proposition relative to a Speaker-based set of epistemically accessible worlds translate to a possibility configuration relative to a context set dependent on common belief?

Formally, a context set and a set of epistemically accessible worlds are derived through exactly the same process. Table 5 shows that they both involve taking as input of a set of propositions and giving as output a set of worlds.

Table 5 Comparing the formal properties of the context set and epistemically accessible worlds

A: a set of propositions	Operation	B: a set of worlds
Common ground	Identify the set of worlds where the propositions contained in A are true as B.	Context set
Modal base		Accessible worlds

Since the set of accessible worlds and the context set are formally both sets of worlds[69], contextual possibility/necessity, which can be defined without reference to the max set, can be applied straightforwardly to either. We have already examined cases of contextual modality made relative to an epistemic modal base. To these we can add cases of contextual modality made relative to the context set. If the common ground entails a proposition p, for example either by containing p directly or by containing a linking proposition $q \rightarrow p$ and its antecedent q, then p will be contextually necessary with respect to the context set. There is another step, however, which is necessary in order to define a human possibility/necessity with respect to the context set: we must define how a common max set can be derived.

The max set of an epistemic modal utterance requires a stereotypical ordering source. A stereotypical ordering source is derived from "stereotypical trends." Stereotypical trends are "known" to be true not as strict entailments but as general trends; they represent generalizations of experiences, and so their entailments are hedged with trend-marking adverbs of quantification, such as "usually/normally." These hedged entailments are contained directly in the modal base. However, as we saw in 2.2.2-3, propositions in the ordering source are specific cases of stereotypical trends. For instance, if Speaker knows the trend, "Usually if it's raining, it's thundering," he can derive

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[69] Of course the content will differ because the propositions in the common ground and the modal base are different.

the proposition "if it's raining in Tokyo, it's thundering in Tokyo" as a stereotypical ordering source proposition. Can this be translated to the common ground?

Every individual has stereotypical trends among their beliefs, believe that all individuals do, and that all individuals believe that they do. The fact that everyone believes some stereotypical trends is common ground. Given that humans, especially those who live in similar environments, have similar experiences, the stereotypical trends which count among their beliefs will overlap significantly, but there will also be unpredictable ways in which they differ. However, for the purposes of an epistemic modal utterance, this is not a problem.

In section 2.2.3, we described the relationship between known stereotypical trends and OS propositions. Here, we will characterize the relationship of stereotypical trends and the possibility/necessity of propositions in the common ground, which will work in the opposite direction from 2.2.3. We start from a given proposition of the form $o \rightarrow p$ in an ordering source and work backwards to find p', the consequent of a related trend and then finally a', the antecedent. This will demonstrate the general process by which a stereotypical trend can be identified as a candidate for deriving a linking proposition for a given human modal assertion. The ability to do this based on the prejacent of a human necessity/possibility assertion is what enables Hearer to evaluate the assertion without knowing exactly what stereotypical trend Speaker has in mind.

In general, we may assume that, for any proposition p, all individuals will have some trend which counts p as a normal/usual state of affairs and some trend which counts $\neg p$ as a normal/usual state of affairs[70]. We can express this common state of belief as follows:

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[70] Logical necessities may have no associated trends that count their falsity as normal states of affairs. It will always be a normal state of affairs that "Three plus one equals four" and never a normal state of affairs that "Three plus four equals three."

It is also conceivable that there are some contingent propositions whose complements cannot be felt to be normal. For instance, every day the sky brightens in the morning. A person who does not understand the mechanism behind this may not count any stereotypical trends where "the sky does not brighten in the morning," among their knowledge.

However, even in such cases it seems that an OS proposition with "the sky does not brighten in the morning" in the consequent could be derived if the stereotypical trend is abstract enough. For instance, "Usually, on alien planets, natural phenomena behave differently from how they behave on earth." If Speaker were envisioning himself on an alien planet y, and the relevant natural phenomenon z is "sky brightening," then, "if I'm on y, z behaves differently from how z behaves on earth," can be derived as an OS proposition. "The sky does not brighten in the morning" would be an instantiation of the consequent of such an OS proposition, so we could also derive an OS proposition of, "if the sky is that of y, the sky does not brighten in the morning." And indeed, it does seem reasonable for a cosmologically-naive Speaker to say, "On Mars, the sky might not brighten in the morning" without having any knowledge specific to why or how the sky brightens in the morning.

Def. 24   Stereotypical trends as common belief

For any proposition p,

$\exists p',x$: p' is a property containing one or more free variables, x is the set of tuples containing values for all and only the free variables in p', and p is an instantiation of $p'(x)$

-and-

$\exists a'$: usually$_x$ if $a'(x)$ then $p'(x)$

-and-

$\exists b'$: usually$_x$ if $b'(x)$ then $\neg p'(x)$

Def. 24 says first that for any proposition p, there is at least one corresponding property p' that has one or more free variables (possibly only time) whose possible assignments are represented by x such that p is a proposition that instantiates $p'(x)$, i.e. p can be derived by assuming specific values to the free variables in $p'(x)$. It also says that there is additionally at least one property a' where $a'(x)$ is stereotypically associated with $p'(x)$, and at least one property b' where $b'(x)$ is stereotypically associated with $\neg p'(x)$. Note that we are assuming that the stereotypical association applies between $a'(x)$ and $b'(x)$, for example, when for most values of x, $a'(x) \rightarrow p'(x)$.

For example, let us assume a p of "it's raining in Tokyo at 3 pm." One possible property p' that can be derived from p is, "it's raining in location y at time t"[71] Given these as relevant values for p and p', Def. 24 says that there will be some property a' which, when it is true of a location y and a time t, "it is raining" is usually also true of y and t. One example of an appropriate such property would be "it's thundering." Taking this example, we get, "usually$_x$, if it's thundering(x), it's raining(x)," where x ranges over location-time pairs $<y,t>$. One case which would be an instantiation of this stereotypical trend would be: "if it's thundering in Tokyo at 3PM, it's raining in Tokyo at 3 pm."

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[71] It would be possible to make the property more specific by fixing either the time or the location. In this case, the tuples in x would only have one value each instead of two. However, in general, the more specific a property is, the less likely it is to be included in a stereotypical trend. This makes sense because the more specific a property is the less frequency one will have had experiences to which it applies (e.g. we will have many more *raining* experiences than *raining in Tokyo* experiences).

Continuing with the same proposition, Def. 24 also says that there will be some property b' which, when it is true of a location y and a time t, "it is <u>not</u> raining" is also usually true of y and t. One example of such a b' would be "it's sunny." Thus, we get, "usually$_x$, if it's sunny(x), it's not raining (x)," where x ranges over location-time pairs $<y,t>$. One case that would count as stereotypical would be: if it's sunny in Tokyo at 3 pm, it's not raining in Tokyo at 3 pm.

In sum, *usually$_x$ if a'(x) then p'(x)* and *usually$_x$ if b'(x) then ¬p'(x)* represent generic templates for any hedged conditional from which a stereotypical ordering source proposition that can serve as a linking proposition for a given proposition p can be derived. The property expressed by p' will be common for both positive and negative trends, but the properties for a' and b', which serve to constrict the domain of the free variables in p' to only cases where p' or $¬p'$ would be a normal state of affairs, are of course different. I propose that this process of relating a proposition to linking propositions derived from stereotypical trends is common knowledge.

Given this common knowledge, we can very generally say that p will be a human possibility with respect to the context set if p is some instantiation of $p'(x)$ in a stereotypical trend *usually$_x$, if a'(x) then p'(x)* and there is an activating proposition a (i.e. that is taken to be true by the evaluator) which is a specific instantiation of any $a'(x)$. As long as the prejacent p is an instantiation of $p'(x)$, it does not matter whether each individual has the same property in mind for a', a different one in mind, of if they don't have a specific one at all in mind.

Building on Def. 24, we can say that a proposition p is a human possibility with respect to the context set if the following is common belief.

(44) $\exists a,a',p'$: *a is true* & *usually$_x$ if a'(x) then p'(x)*, where a and the prejacent p are parallel instantiations of a stereotypically associated $a'(x)$ and $p'(x)$, i.e. instantiations having identical values substituted for x.

Put simply, (44) says that there is some aspect (time and/or individuals (which can include places and/or people)) of the case referenced by the prejacent which is stereotypically associated with the truth of the prejacent. Naturally, if and when a discourse participant makes a modal assertion where p is the prejacent, Hearer will know

that whatever the ordering source propositions are that Speaker has in mind, they are instantiations of *usually$_x$ if a'(x) then p'(x)* and *usually$_x$ if b'(x) then ¬p'(x)*where *p* is an instantiation of *p'(x)*. Calculating from *p*, then, Hearer back-calculates to see if there are individuals or a time in *p* which truthfully instantiate the variables in *if a'(x) then p'(x)* to see if Speaker is correct, and in *if b'(x) then ¬p'(x)* in order to see if she should disagree with Speaker.

As mentioned above, (44) allows the discourse participants to each draw on different instantiations of a given *a'(x)* and *b'(x)* (e.g. one participant may use *Tokyo* as a place value while the other uses *East Japan*) or even different trends (e.g. one may use "it's thundering in location *y* at time *t*" for *a'* or b' while another uses "it's humid in location *y* at time *t*") as long as the trends and instantiations are in line with (44). This flexibility is necessary to account for actual discourse events because discourse participants can and do arrive at the same conclusion, i.e. that a proposition is humanly possible/necessary, based on different instantiations of trends or even different trends altogether.

Let us look at an example to see why the generality of (44) is essential for determining the contribution made by a human possibility/necessity utterance to the common ground. We will also see that supposing a common ordering source is not realistic or necessary.

Suppose Speaker and Hearer are American tourists visiting Tokyo. They are in their hotel getting ready to head to the park, when Speaker utters, "Did you hear the thunder just now? It might be raining." This is Speaker's first time in Japan, so what kind of general trend could he have in mind? He will be likely to apply the weather trends he learned in the US to Tokyo, but he is not likely to have specific beliefs about usual weather in Tokyo i.e. he is unlikely to count for example, *usually, if it's thundering in Tokyo, it's raining in Tokyo* as a belief. The same applies to Hearer. Since the OS proposition is not a previously established belief but is rather derived from general trends, there is room for Speaker and Hearer to derive different ordering source propositions.

Let us suppose that Speaker derived "if it's thundering in Tokyo, it's raining in Tokyo" as an ordering source proposition from a general trend proposition "usually$_{y,t}$, if it's thundering in place *y* at time *t*, it's raining in place *y* at time *t*." For Hearer's part, when "It might be raining" is uttered, she will know based on the prejacent that whatever Speaker has in his OS, it was derived from a general trend which fits the form *if a(<location y, time t>)*

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then it is raining(<location y, time t>), and will choose some location which is or subsumes their current location. For instance, Hearer might derive, "If *a(<East Japan, now>)*, it's raining in East Japan." Although the value for the location *y* is different from Speaker's, it conforms to (44).

In addition to choosing a property *p′* which *p* can be an instantiation of and deciding which individuals (or possibly only times) in *p* are variable in *p′*, Hearer must find an *a′* which ranges over the same variables and which is stereotypically associated with *p′*. In this case, she must find an *a′* which ranges over places and is associated with *it's raining(x)*. As we saw above, Speaker has uttered "It's thundering" so in this case Hearer can infer with confidence what stereotypical trend Speaker has in mind. We will suppose that she also believes *usually if it's thundering (x), it's raining (x)* based on her own experience in places in the US. Then, depending on whether she believes that it is thundering in the location she chose (East Japan), she can evaluate whether to accept Speaker's modal assertion. If she does accept it, (44) is added to the common ground, despite the fact that Speaker's instantiation of *usually if a′(x) then p′(x)* is different from Hearer's.

(44) captures the part of the interaction between Speaker's intention and Hearer's interpretation which will always be in common while allowing the parts which are distinct to be distinct. Another possibility is for Hearer to apply a different trend associated with rain. She might also come up with *it's humid(x)* or *the weather report called for rain(x)*, etc. Either of these would qualify as potential values for *a′(x)*. (44) only requires that there be some general trend proposition which stereotypically entails the prejacent, and that there be an activating proposition *a* which is true and is an instantiation of whatever the *a′* is in that general trend proposition.

A principle goal of this section was to show how a common stereotypical max set could be derived. We can say that any world in the context set at which (44) is true can be said to be a member of the common stereotypical max set. This, of course, is equivalent to saying that (44) is in the common ground. If the common ground includes (44) but does not contain or entail a proposition *p*, if any given individual were to make a truthful modal utterance compatible with the common ground, they would have to say *may/might p*. Therefore, it is common ground that *p* is a human possibility.

In order to ensure that all discourse members can truthfully say *must p* another belief must be included in

the common ground.

(45) $\neg\exists b,b',p'$: *b is true & usually$_x$ if b'(x) then ¬p'(x)*, where *b* and the prejacent *p* are parallel instantiations of a stereotypically associated *b'(x)* and *¬p'(x)*.

Because the ordering source-based ordering has the potential to produce disconnected branches of ordered worlds, if there might be a *b* satisfying the restriction in (45) that is contextually possible in the common ground, then the prejacent *p* in that restriction is not a human necessity. However, it is a human necessity in the common ground if (45) is common belief. *P* can be said to be humanly possible relative to any context set corresponding to any common ground which includes (44), and humanly necessary relative to any context set derived from any common ground which includes (44) and (45).

We have now shown how epistemically accessible worlds and the stereotypical max set can translate to the common ground. Now we can lay out how a modal assertion based on a Speaker-relative epistemic modal base and stereotypical ordering source can update the possibility configuration of the prejacent relative to the common ground.

3.3.4 Updating the common ground with necessity assertions

For Speaker to truthfully assert a human necessity, he must believe (44) $\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x)*, where *a* and the prejacent *p* are parallel instantiations of a stereotypically associated *a'(x)* and *p'(x)*, i.e. instantiations having identical values substituted for *x*. and (45) $\neg\exists b,b',p'$: *b is true & usually$_x$ if b'(x) then ¬p'(x)*, where *b* and the prejacent *p* are parallel instantiations of a stereotypically associated *b'(x)* and *¬p'(x)*. The Level 1 truth conditions for the Speaker's assertion only require that there be such an *a* and that there be no such *b* in Speaker's modal base. By definition, Speaker believes propositions in his epistemic modal base to be true. Hearer will assume by common belief that Speaker believes what he asserts, and will believe that he believes everything necessary to make it true. Furthermore, by the quantity maxim, Speaker and Hearer both believe that Speaker wants to update the

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common ground. If (44) and (45) are accepted into the common ground, the prejacent will effectively be a human necessity with respect to the context set. Therefore, Hearer will believe that Speaker wants her to believe (44) and (45).

In practice and as per Def. 24 (p. 126), since the fact that there are general stereotypical trends for both the prejacent and its complement is already common ground, what a human necessity assertion will do is to strengthen this common belief so that there are instantiations of the antecedent of such a stereotypical trend which are true, as follows:

The effect of a successful human necessity assertion on the common ground

$\exists a,a',p'$: *usually if a'(x) then p'(x)* -> $\exists a,a',p'$: *a is true* & *usually if a'(x) then p'(x)*[72]

$\exists b,b',p'$: *usually if b'(x) then ¬p'(x)* -> ¬$\exists b,b',p'$: *b is true* & *usually if b'(x) then ¬p'(x)*

This means that, in maintaining the quantity and quality maxims, Speaker must be proposing that Hearer accept these two propositions.

Recall Stalnaker's conditions for being a pragmatic presupposition:

A) Speaker is disposed to act as if he takes the truth of p for granted

B) Speaker is disposed to act as if he assumes that his audience recognizes that he is doing so.

It is an empirical fact that epistemic modal assertions do not require Speaker to believe that any knowledge which is relevant to the modal assertion, i.e. situation-specific instantiations of $a'(x)$ or $b'(x)$, is common ground in order to be asserted. As such, it is often the case that such specific instantiations will not be pragmatically presupposed. That is, whatever Speaker considers relevant knowledge (i.e. the situation-specific instantiations of $a'(x)$ and/or $b'(x)$), it will often not satisfy (B).

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[72] From here on I will use this abbreviated version of the propositions. In all cases I am assuming the full definitions.

However, regardless of this, we can say that Speaker presupposes that Hearer will recognize that he is presupposing the situation-general propositions, i.e. that there is some *a* which is an instantiation of *a'(x)* in (44) and is true, and there is no *b* which is an instantiation of *b'(x)* in (45) and is true. Since the truth conditions require Speaker to believe the situation general proposition to be true and common belief says that Hearer believes that Speaker asserts only what he believes, both (A) and (B) are satisfied. Thus, because quantity requires that Speaker want to update the common ground and quality requires him to believe what he is asserting, what were truth conditions confined to the modal base at Level 1 become pragmatic presuppositions which are non-modal propositions for evaluating whether to accept the assertion at Level 0.

3.3.5 Updating the common ground with possibility assertions

The quantity and quality maxims have similar affects on human possibility assertions. In the case of human possibility, the quantity maxim plays a central role in determining the propositional content of the assertion. The truth conditions of human possibility do not require Speaker to know anything, i.e. they allow a lack-of-knowledge reading, but, as we saw, the possibility configuration of a proposition can be updated if a linking proposition is present in the modal base or the ordering source, and the antecedent of that linking proposition is present in the modal base[73]. For a possibility assertion to update the context set, a linking proposition with a true antecedent must be believed to exist in the common ground.

When a linking proposition is in the modal base, the ordering source can be empty. The possibility configuration can be updated through what might be best called an "impossibility update" by deactivating the linking proposition in the modal base. In this case, felicitously asserting possibility *may p* results in affirming that a proposition is not contextually impossible. This requires, by scalar implicature, that the complement of *p* be an instantiation of the consequent.

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[73] Formally the presence of the antecedent in the OS would also assure that consequent is a human possibility. However, stereotypes do not change so easily and are generally assumed to be shared, so even if the antecedent were in the OS, it would not require an update. Add to this the fact that the antecedent of linking propositions express characteristics of the situation rather than relations among propositions, and it is all together unlikely that the antecedent would qualify for membership of a stereotypical OS.

A specific case of a linking proposition in the modal base will come from a universally hedged trend using an adverb such as *always*. Unlike with *usually*, any instantiation of a property which can truthfully be quantified over by a universal operator like *always* is guaranteed to be true. Thus, for an instantiation of p of a universally hedged trend, the ordering function has no role to play since p will be true in every accessible world. This is why universally hedged trends underwrite contextual necessity. Consider the following trend:

(46) Always, if a person has just come in with a wet umbrella ($=a'(x)$), then it is raining outside ($=p'(x)$).

An OS proposition based on (46) would have to instantiate *if a person has just come in with a wet umbrella(<location y, time t>), then it is raining outside(<location y, time t>*. If instantiations of this trend are taken to be part of the modal base, then upon seeing a person come in with a wet umbrella, an utterance of *may p*, where p is an instantiation of *it is raining outside(<location y, time t>*, would be truthful, but it would either violate the quantity maxim via scalar implicature or violate the quantity maxim via not updating the common ground. That is, if there is a person who just came in with a wet umbrella, p is a contextual necessity so Speaker would be quired by the quantity maxim to say *must p* instead of *may p*; if there is no person with a wet umbrella, i.e. no a which is an instantiation of $a'(x)$ and is true, then the uttered proposition is true but it does not change the possibility configuration of the prejacent, again violating quantity but this time by not contributing anything to the common ground. However, if it is common ground that Speaker might know whether or not there is an a which is an instantiation of $a'(x)$ which is true, and if Speaker utters *may ¬p*, the utterance can update the common ground. Perhaps Speaker and Hearer have to stay indoors where there are no umbrellas, and Hearer has instructed Speaker to look out for sure signs that it's raining outside. In this case *may ¬p* entails that there is no instantiation of $a'(x)$ which is true.

Now recall DeRose's example (=(27) John might have cancer.), where John had a cancer test. If the test is positive, he may have cancer. If it is negative, he cannot have cancer. In other words, negative results entail that John does not have cancer but positive results preserve the possibility. This is an instance of '*if a then ¬p*' in the modal base, where a is "The test results are negative" and ¬p *is* "John does not have cancer." Asserting *may p*, thus, can

update the common ground by deactivating the linking proposition, i.e. by requiring that *a* not be known to be true. On the other hand, asserting *may ¬p* in this case would not require an update. John's not having cancer is possible without knowing whether *a* is true or false.

Cases where Speaker has access to information that would entail the contextual necessity of *¬p* are usually presumed to be beyond the epistemic reach of discourse participants. For instance, if Speaker did not believe that Hearer knew that he was in a position to know the results of a decisive cancer test, Speaker would almost certainly not be in a position to update the common ground with a proposition that entails that it is impossible that John has cancer.

The ordering source provides a much easier way for Speaker to be able to update the common ground with a *may* assertion. As we have seen, more than often with possibility assertions, it is presupposed by all or most discourse participants that the prejacent is not contextually impossible and that no participant will be able to rule it out conclusively[74]. On the other hand, a human possibility assertion relative to a stereotypical ordering source can require an update in all cases where *p* **is <u>no more than</u> contextually possible <u>in the common ground</u>.**

When neither *∃a,a',p':a is true & usually if a'(x) then p'(x)* nor *∃b,b',p': b is true & usually if b'(x) then ¬p'(x)* is common ground with respect to a given proposition *p* which is an instantiation of *p'(x)*, the possibility configuration of *p* can be updated to Configuration 3, 4 or 5 relative to the context set without contradicting any existing common ground propositions[75]. I shall refer to this state of the common ground as "no more than contextual possibility" to make the contrast with the case in which slight possibility is ruled out, i.e. in which the Possibility Configuration is already constrained to 3 or 5, clearer.

For Speaker to consider asserting a human possibility modal *may p*, he must believe that there is at least one participant who believes no more than that *p* is contextually possible, or even specifically that *p* is slightly possible. Recall that contextual possibility is compatible with both slight and human possibility. When Speaker believes that a proposition is humanly possible and another participant believes that it is slightly possible, they still agree that it is

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[74] Of course this is not always a <u>warranted</u> presupposition, and this is when Hearer will chime in saying that actually the prejacent is false.

[75] Such an update may contradict the discourse commitments of individual participants. We will explore this situation in Chapter 4.

contextually possible. On the other hand, when all the other participants believe that p is humanly possible or even humanly necessary, providing that all participants are aware of all participant's beliefs, p will be humanly possible in the common ground (since human possibility is entailed by human necessity) and fail to satisfy the condition above.

Thus, in any case where p is no more than contextually possible relative to the context set, Speaker can update the context set to human possibility with (44) $\exists a, a', p'$: *a is true & usually$_x$ if a'(x) then p'(x)*, where a and the prejacent p are parallel instantiations of a stereotypically associated $a'(x)$ and $p'(x)$, i.e. instantiations having identical values substituted for x. Acceptance means that all participants accept that there is such an instantiation of $a'(x)$ which is true.

Next we will compare the pragmatic presuppositions of human necessity and human possibility assertions. The table below gives the pragmatic presuppositions systematically produced by epistemic human possibility and necessity assertions given the quantity maxim.

Table 6 Pragmatic presuppositions of human possibility/necessity assertions given the quantity maxim

	Human Possibility	Human Necessity
Evidence for p	$\exists a, a', p'$: a is true & usually if a'(x) then p'(x)	$\exists a, a', p'$: a is true & usually if a'(x) then p'(x
Evidence for $-p$	Speaker believes $\exists b, b', p'$: b is contextually possible & usually if b'(x) then ¬p'(x)	$\neg \exists b, b', p'$: b is true & usually if b'(x) the ¬p'(x)

A quick look at Table 6 reveals that the only difference in the pragmatic presuppositions of human possibility and human necessity is with regards to positive evidence for the complement of the prejacent. When Speaker makes a human possibility assertion, Hearer will assume that Speaker does not believe he knows that there is no b which both instantiates the antecedent of a trend usually *if b'(x) then ¬p'(x)* and is true. This assumption comes from the quantity/quality-based belief that Speaker will make as strong of an assertion as he is capable of, commonly referred to as scalar implicature. According to this belief, if Speaker knew that the prejacent were a human necessity, and thus

that there is no such *b* which is true, he would use *must*. Since he has used *may/might* instead, he must not be able to rule out that the complement of the prejacent is not also a human possibility.

In sum, a human possibility assertion *may p* pragmatically presupposes that positive evidence for the complement of *p* is at least contextually possible, while human necessity pragmatically presupposes that there is no positive evidence for the complement of *p*. The presuppositions of human possibility allow that the prejacent might be a human necessity, as in Configuration 3, or that both the prejacent and its complement are human possibilities, as in Configuration 5. This aligns with entailment patterns as it should.

3.3.6 Section summary

In this section we saw that modal assertions can be taken to serve as updaters of possibility configurations as non-modal assertions are updaters of truth values. This is made possible by pragmatic presuppositions which are systematically produced by human possibility/necessity utterances through their interaction with the common ground and the Cooperative Principle. The presuppositions themselves are essentially non-modal propositions deduced from the truth conditions of human modality as constrained by the quality-quantity maxim. It is because these presuppositions can be derived that modal assertions can function as objective proposals for the common ground.

Thus, in answer to the question raised in 3.1.3, I propose the following: Modal assertions at Level 0 are proposals to update the common ground in such a way that certain situation-general pragmatic presuppositions, (44) in the case of human possibility and (44) and (45) in the case of human necessity, are entailed, which in turn changes the possibility configuration of the prejacent relative to the context set.

Note that this requires no added structure to the propositional nature of the common ground, it merely describes logical interconnections which exist within it due to system-external factors (i.e. humans wanting to categorize propositions according to likeliness). We could assume that a proposition such as "prejacent *p* is humanly necessary" or "prejacent *p* is in Configuration *n*" is added to the common ground, or we may maintain that this is merely a label to make it easier for researchers to refer to configurations of the common ground.

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3.4 Hearer derivation of the pragmatic presuppositions of modal assertions

In this section, I will show the process by which the pragmatic presuppositions necessary for a Level 1 modal assertion, i.e. an objective modal assertion, are derived. This process has several spots where the conditions may or may not be met by the discourse event, and this can result in the modals behaving in different ways in different discourse events. After laying out the standard deductive process, in the following section I shall give some predictions for behavior in discourse that this process allows for. I will give me accounting for the problems raised in 3.2 using these predictions.

3.4.1 The derivation process

The table below details the process of deduction for deriving pragmatic presuppositions.

Table 7 The derivation process of pragmatic presupposition for modal assertions

	May p	*Must p*
i.	Speaker has asserted that *p* is an epistemic possibility.	Speaker has asserted that *p* is an epistemic necessity.
ii.	Speaker believes that we believe that he is a cooperative (sincere & informative), competent speaker of English. (by standard common belief).	
iii.	Speaker intends to update the common ground (By ii.).	
iv.	Speaker has used a modal instead of a non-modal, so he must intend to change *p*'s possibility configuration w.r.t. the common context set.	
v.	Since Speaker has used a possibility modal, he probably does not know that *p* is true or false (By ii).	Speaker has used a necessity modal, so he probably[76] does not have direct evidence for *p* (by the manner maxim).

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[76] The use of *probably* is important here. In the next chapter, where I discuss how modals influence discourse, it will be seen that the possibility that Speaker intends contextual necessity is not ruled out until the common ground entails that it is ruled out.

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vi.	Human possibility relative to a null ordering source is equivalent to contextual possibility.	Human necessity relative to a null ordering source requires very strong evidence.
vii.	If Speaker intended a null ordering source, there would be no update (unless he is addressing a question under discussion as to whether p is false).	Considering (v.), Speaker probably does not have such strong evidence.
viii.	Therefore, Speaker must intend a non-null ordering source (by the quantity maxim).	Therefore, Speaker must intend a non-null ordering source (by the quality maxim).
ix.	To change the possibility configuration of p without adding p or $\neg p$ to the common ground, there must be a linking proposition.	
x.	Therefore, Speaker probably has a proposition which adheres to the form *if a then p* in his OS.	
xi.	For a linking proposition to change the configuration of p at utterance time, it must be active.	
xii.	Therefore, Speaker must believe that the antecedent of the linking proposition, i.e. *a*, is true.	
xiii.	A stereotypical ordering source is composed of conditionals which are instantiations of stereotypical associations.	
xiv.	In following, Speaker must believe $\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x)*.	
xv.	We do not know the specific contents of Speaker's beliefs, so we can't evaluate whether his beliefs really entail $\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x)*.	
xvi.	Speaker may or may not be presupposing that his instantiation of $a'(x)$ is in the common ground (by empirical fact).	
xvii.	Since it is required for us to maintain (ii), Speaker must believe that we will accommodate $\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x)* even if we don't know the contents of an appropriate such *a*.	
xviii.	Therefore, Speaker must be pragmatically presupposing $\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x)*	
xix.	Speaker is asserting human possibility and not human necessity.	Speaker is asserting human necessity.
xx.	Speaker will make the strongest assertion he is confident in. (By scalar implicature).	Therefore, Speaker must believe $\neg p$ to be a slight possibility.

xxi.	Therefore, Speaker must not know p to be a human necessity.	Therefore, Speaker must also believe $\neg\exists b,b',p'$: *b is true & usually if b'(x) then* $\neg p'(x)$.
xxii.	If Speaker did believe $\neg\exists b,b',p'$: *b is at least contextually possible & usually if b'(x) then* $\neg p'(x)$, then Speaker's beliefs would entail that p is a human necessity.	
xxiii.	Since Speaker knows that I believe (xxii.), in order to maintain (ii.) he must believe that I will believe that he at least believes that $\exists b,b',p'$: *b is at least contextually possible & usually if b'(x) then* $\neg p'(x)$ if not $\exists b,b',p'$: *b is true & usually if b'(x) then* $\neg p'(x)$.	Since it is required for us to maintain (ii.), Speaker must believe that we will accommodate $\neg\exists b,b',p'$: *b is true & usually if b'(x) then* $\neg p'(x)$.
xiv.	Speaker must be pragmatically presupposing 'Speaker at least believes '$\exists b,b',p'$: *b is at least contextually possible & usually if b'(x) then* $\neg p'(x)$ ' and '$\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x).*'	Speaker must be pragmatically presupposing '$\neg\exists b,b',p'$: *b is true & usually if b'(x) then* $\neg p'(x)$' and '$\exists a,a',p'$: *a is true & usually$_x$ if a'(x) then p'(x).*'

3.4.2 Predictions from the process of Speaker presupposition derivation

We can make several predictions based on the reasoning process in Table 7.

A) By (iii.), since Speaker intends to update the common ground, whether Speaker deems it appropriate to make a modal assertion and what kind of modal assertion he chooses will depend on how he perceives the state of the common ground. This means that a given utterance's appropriateness will vary depending on who the discourse participants are.

B) By (ii)-(iv), since Speaker intends to update the common ground in the way the discourse demands with as much information as he believes he can provide, when there is a discourse question which demands an answer regarding contextual necessity, a null-ordering source will be assumed instead of a stereotypical one.

C) When (xvii) is a valid belief, i.e. Hearer trusts Speaker's epistemic authority and sincerity and has no conflicting

evidence causing her to doubt his assertion, acceptance at the most general level will occur.

D) When (xv) is not satisfied, i.e. when it is not the case that Hearer cannot know the contents of Speaker's knowledge, a modal assertion should be able to be contradicted at Level 1. This would mean that the uttered proposition would be false, rather than just unacceptable as a Level 0 assertion.

E) (xvi), i.e. that Speaker may or may not believe his instantiation of $a'(x)$ is entailed by the common ground, allows that Hearer look for candidates for such an instantiation in the common ground. This can result in her finding a different stereotypical trend than what Speaker intended, and make inferences as to what situation-specific content Speaker believes.

    E.1   Speaker should be able to count on this behavior of Hearer to indirectly confirm that background assumptions are indeed common knowledge.

    E.2   Depending on whether the relevant beliefs are in the common ground or in Hearer's private knowledge, Hearer can have different reactions to Speaker's assertion.

F) (xvii), i.e. Speaker's assumption that Hearer will accommodate his pragmatic presupposition, can lose validity if the human possibility of the prejacent is disagreeable or surprising to Hearer. When Speaker believes this is the case, he will be more likely to make the situation-specific content of his instantiation of $a'(x)$ explicit and Hearer will be more likely to present evidence for the prejacent's complement (i.e. an instantiation of $b'(x)$.

G) In the case of a human possibility assertion, (xxiii), i.e. the fact that Speaker is not committed to the non-existence of a true instantiation of $b'(x)$, allows Hearer to refine (as opposed to contradict) Speaker's beliefs to human necessity, i.e. Configuration 3, by means of asserting that there is no appropriate values for b that is true.

H) On the same note, Speaker may also believe that there is an appropriate b that is true when he makes a human possibility assertion, (that is, his belief state regarding the prejacent corresponds to. Configuration 5).

3.5 Some answers to riddles

In this section, I will show that all of the issues raised in section 3.2 can be adequately addressed using the predictions made by the pragmatic presupposition derivation process. I am assuming a completely solipsistic modal

base. The active factor in accounting for variable truth judgments is not a modal base which includes sources of knowledge other than Speaker, but a linking proposition in the modal base or ordering source, whose presence is required by the quantity-quality maxim. In order to activate these linking propositions and thus make a felicitous assertion, Speaker has to have knowledge corresponding to the antecedent of such linking propositions, and the content of these linking propositions are subject to discourse-specific demands.

3.5.1 Valid truth conditions and only a solipsistic modal base thanks to the quantity maxim

We shall start by addressing the concerns which were taken to motivate supposing a modal base which is relative to sources of information other than Speaker's knowledge, raised in 3.2.1. First, recall DeRose's example.

(28)   I've heard that John might have cancer. Is it true?

    a   (Jane) He might have cancer

    b   (Jane) <u>I don't know whether he might have cancer</u>; only the doctors know. I'll find that out tomorrow when the results of the test are in.

Jane can reply with either (a) or (b). (a), according to DeRose's account, is relative to only Jane's knowledge, or potentially a small community which does not include the doctor, such as her family. (b) is relative to a community including the doctor; Jane wants to make an assertion based on the doctor's knowledge, but does not know what it is, so she has to confess that she does not know.

However, the observations can be explained more simply with prediction (A), which says that whether Speaker deems it appropriate to make a modal assertion, what kind of modal assertion he chooses will depend on how he perceives the state of the common ground, and thus on who he is talking to. Prediction (B) will also be involved: when there is a discourse question which demands an answer regarding contextual necessity, a null-ordering source will be assumed instead of a stereotypical one.

According to my analysis, the fact that Jane can truthfully utter either (a) or (b) is just a result of different

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discourse demands. In both cases we assume that John has had a cancer test done, that the doctors know the results of the test, and that Jane doesn't. As a situation in which (a) is appropriate, suppose a Hearer who neither knows that John had a test nor has heard from Jane's mouth that John might have cancer. (a) would then update the common ground even if John had not had a cancer test done as long as Jane has some evidence for his having cancer. Although he makes no deliberate note of it, DeRose himself includes Jane's possession of evidence in the situation he portrays for a felicitous assertion of (a): "It's possible that John has cancer. He has some of the symptoms" (p. 582). Note that in this situation, if Jane did not know about the test, an "I don't know answer" would not be appropriate.

As a situation in which (b) is appropraite, consider the case where Jane poses her own linking proposition, which as part of Jane's overt and, we assume, unchallenged assertion goes into the common ground and hence into the modal base: if the test results are negative, John does not have cancer. As prediction (B) says, in this case the ordering source is empty. To be able to upgrade the common ground in accordance with the discourse demand that she posed herself, Jane must know whether the antecedent is true or false. That is, given a common ground which includes the fact that John has had a cancer test, (28) poses two propositions just like a polar question, one which entails that the test results are negative and one which entails that they are positive. Jane does not know which is correct, and thus she "does not know." In this case, either (a) or (b) would satisfy the quantity maxim, if Hearer doesn't know about the test until Jane tells her. If Hearer does know about the test and also already knows, and is known to know, that John had the test precisely because there is a possibility of his having cancer, then only (b) would satisfy the quantity maxim, making (a) inappropriate. This dependence on the common ground is made clearer in the following situation.

John and Jane's son, Bob, is calling from a business trip. He knows from his mother that John had some symptoms of cancer, had a test done and that the results come in today. Unable to wait for her to call him, he calls up her up.

(47)   Bob: Might Dad have cancer?

        c: (Jane) He might. #He has some symptoms.

        d: (Jane) He might. The results came in positive.

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e: (Jane) I don't know yet.

As we can see in (c), Jane could not make a felicitous assertion relative to a stereotypical ordering source in the case that John's having had a test is common ground. In this case, the stereotypical possibility of John's cancer is already established. That is, *∃a,a',p': a is true & usually if a' then p'(x)* is entailed by the common ground[77]. John does have symptoms, that is why he had a test in the first place, and both participants n the conversation know this and know each other know this. On the other hand, *∃b,b',p': b is contextually possible & always if b' then ¬p(x)* is also entailed by the common ground. Note that "always " is used in this entailment relation. This linking proposition can render John's cancer contextually impossible, and so the truth value of the antecedent is informative with respect to the common ground in (47). To this, Jane can say (d) if she knows the results to be positive and (e) if she does not know the results at all yet. Note that I have included Jane's evidence in (c) to clarify which reading of *might* is intended, but if Jane uttered just "He might," it is clear that Bob would interpret her assertion to mean that she knows that the results are positive.

Given the above, there is no need to suppose that Jane wants to somehow make an assertion based on a modal base including the doctor's knowledge. The only assumption needed is that she is abiding by the cooperative principle, and thus needs to know the truth value of the antecedent of a linking proposition.

Next we shall address the issue of practicable investigation.

A member of a salvage crew searching for a sunken ship makes some calculations based on a ship log the crew recovered and claims,

(29) "The wreck may be in this bay."

Speaker made a mistake in his calculations based on the ship log, whose contents actually entailed that the ship could not be in the bay Speaker referred to. In this case, it was noted that most would judge the utterance as

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[77] Recall that the prejacent is an instantiation of *p'(x)*.

false. Hacking and DeRose explain this by making truth relative to "practicable investigations" (Hacking, 1967, p. 149): (29) will only be true if there is "no relevant way by which members of the relevant community can come to know that *p* [=(the wreck in this bay)] is false" (DeRose, 1991, p. 594). The falsity of (29) is taken to come from the fact that this requirement is not met in (29). However, we also noted a difference in intuition between (28a)(=(Jane) He might have cancer) and (29). Given that Jane had an unopened letter with the test results in her hand, she too has a way by which she could to know that p [=He has cancer] is false. However, she could still truthfully utter (28a) based on the fact that John had shown some symptoms of cancer. Since both seem to be a "relevant way of coming to know" or "a practicable investigation," it was unexpected that there was a difference in intuition.

Under my proposal, the distinction between these examples can be accounted for by prediction (D). When (xv) is not satisfied, i.e. when it is not the case that Hearer cannot know the contents of Speaker's knowledge, a modal assertion should be able to be contradicted at Level 1. This would mean that the uttered proposition would be false, rather than just unacceptable as a Level 0 assertion.

We saw that Level 1 acceptance is usually automatic for epistemic modal assertions because Hearer cannot know the exact contents of Speaker's knowledge. However, if Speaker is ostensibly claiming to have based his conclusion on some piece of information which others also can have direct access to, then this condition is not met. This means that in the case of (29), the utterance is false on the propositional level. Of course, this depends on Hearer somehow already knowing Speaker is incorrect or being able to interpret the ship logs better than Speaker.

As for Jane being able to say (28a) even when she has an unopened letter with the test results, this is because she has not yet read the letter and thus does not claim its contents as her knowledge. Even if Hearer does know the contents of the letter and thus that John cannot have cancer, since it is common ground that Jane does not, her utterance will not be false at Level 1, only Level 0. The appropriateness of (28a) vs. (28b) will be exactly the same as above. In this case, the truth and falsity judgments are products of considering the "stores of information" as part of Speaker's knowledge. There is no reason to assume a non-solipsistic modal base.

(von Fintel & Gillies, 2011, p. 112) present a similar situation.

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Reading through his interview notes, Schmolmes makes some errors in his deductions and declares:

(48) Ah, the gardener might be the culprit.

Given the knowledge not that the gardener is not the culprit, but that the gardener not being the culprit can be established by the notes on which Schmolmes based his conclusion, most will judge (48) as false. Interview notes are stores of information which other people can "know" exactly as Speaker can know them, and so (48) is false at Level 1. Portner suggests that situations like this could be characterized as "objective" (as opposed to intersubjective) to that extent that "G (the group of knowers in the modal base) contains a reliable, non-human source." (p. 166). He does not say what this categorization would be useful for. I argue that this objectiveness can be accounted for in a solipsistic modal base, where the factor which effects our truth judgments is whether we believe Speaker to be taking the contents of some publicly available source of information as his own knowledge[78].

Next we shall address the issue of agreement and disagreement.

(30)   Sally: Joe might be in Boston. (= It might be the case that Joe is in Boston.)

George: He can't be in Boston. (= It is not the case that it might be the case that Joe is in Boston.) I saw him in the hall five minutes ago.

Sally: Oh, then I guess I was wrong.

Here we had two problems. One was that if Sally's assertion is relative to a solipsistic modal base then George should have no reason to argue since its truth depends on Sally's private knowledge. The other is that Sally should not have to admit she was wrong, because the proposition originally uttered would still have been correct given her knowledge at utterance time.

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[78]   von Fintel & Gillies point out in a footnote that judgments regarding (48) are not entirely uniform. This is not unexpected, since the judgment that an utterance is false at Level 2, as opposed to being an unacceptable assertion at Level 1, depends on the subjective judgment of the evaluator as to whether it is possible to know all the relevant facts that Speaker knows. Whether someone can "know" the contents of a log or interview notes in the same way is certainly open to debate. Nevertheless, in cases where Speaker claims stores of information as his knowledge, it will be common for onlookers to conclude falsity at Level 2 if he is mistaken. This suggests that they do take themselves to have the same relevant knowledge as Speaker.

Given the pragmatic presuppositions at Level 0, it is completely natural for George to argue. Sally's first utterance presupposes $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x)*. If this is accepted into the common ground, "Joe is in Boston," as an instantiation of $p'(x)$ becomes humanly possible relative to the common context set. However, as we saw in 3.1.2, discourse is an interactive process where rejection also plays a central role in preserving the integrity of the common ground[79]. Hearer will typically almost instinctively reject proposals that he knows to be false. In this case, Hearer knows that it is contextually impossible for Joe to be in Boston. He then makes his own modal claim, this time with the linking proposition in the modal base: if Joe was in the hall 5 minutes ago, he is not in Boston. Sally, upon accepting this, has to admit that her presupposition was "incorrect."

More accurately, her presupposition does not produce valid OS propositions. Acceptance of George's utterance causes the common ground to entail $\neg p$. When an OS proposition *if a then p* is derived from Sally's presupposition $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x)*, assuming that whatever Sally's intended instantiation of $a'(x)$ is true, the OS proposition will be false in all accessible worlds. Since it cannot affect the max set, there will of course be no p-worlds in the max set. If there are no p-worlds in the max set, p is not a human possibility. This does not entail an admission that her assertion was false at Level 1 as $\neg p$ was not entailed by the modal base. In fact, it was because George believed that it was valid at Level 1 that he inferred a pragmatic presupposition with which to argue in the first place.

The problem of the eavesdropper also does not arise given this analysis. Sally's presupposition is not tied to any specific group or community and hence not to a particular addressee, though it is tied to the utterance time. Anyone who might want to upgrade their beliefs via Sally's assertion will be interested in the validity of her pragmatic presupposition.

Thus, we have covered all of the motivations for supposing a non-solipsistic modal base, and found that all of them can be addressed by adopting a solipsistic modal base once we factor in the quantity maxim. A linking proposition is needed to update the common ground, and hence to satisfy the quantity maxim, and the felicity of

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[79] This will be laid out in a more explicit fashion in Chapter 4, where I show how modal assertions function as posers of "modal issues".

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Speaker's assertion is dependent on his ability to activate it. This explained when and why Speaker would say "I don't know if *may p*." This also allowed us to separate failures in propositional truth (Level 1 acceptance) like in the ship log example and acceptability as an assertion (Level 0 acceptance) like in instances of disagreement, because it allows Hearer to derive pragmatic presuppositions which originate from but are not part of the propositional content.

Next, I will show how this framework can also account for all of the pragmatic issues raised in 3.2.2.

3.5.2 One mechanism fits all: Subjective=objective=proffering=asserting

In section 3.2 we explored investigations focusing on the interpretation of modal assertions. The literature has categorized assertions into objective and subjective assertions based on an intuition of what Hearer can react to. For objective modal assertions she can dispute specific facts, but for subjective modal assertions she can only respond with her own subjective modal assertion. On the other hand, some modal assertions seem to proffer their prejacent as an answer to a discourse question rather than assert the necessity/possibility of the prejacent. Instances of this were classified as "proffering" and differentiated from plain modal assertion.

In this section, I will show that all four of these categorizations are manifestations of standard assertion applies to modal propositions, differing on the surface due to the overlap or lack of overlap between the modal base and the common ground. The fact that differences in the common ground cause modal assertions to be interpreted as carrying out different functions is natural if we consider that the goal of assertions is to update the common ground in a way consistent with the discourse demand and that a different common ground will require updates of different content to accomplish this.

3.5.2.1 Proffering

We shall start with an example of proffering. In this section I aim to show that there are two main factors in for this speech act function: [1] the ability of the modal base to quantify over the knowledge available at the time of assertion and [2] quantity-restricted semantics working to show Speaker's commitment to the stereotypical human possibility/necessity of the prejacent in the common ground This will show that no additional

conventionalization need be stipulated.

(40)   Q: Why isn't Louise coming to our meetings these days?

    A: She might/must be too busy with her dissertation.

        i: #Because it's possible that she is too busy with her dissertation.

        ii: It's possible that it's because she's too busy with her dissertation.

In section 3.2.2.6, we saw that the fact that "Louise is too busy with her dissertation" is possible is taken for granted, and that (A) seems to be acting as a speech act proposing the prejacent as a possible answer to (Q), as in the reading in (ii). This reading corresponds to Speaker's guess as to why Louise has not been to meetings. The reading in (i), which would be the expected reading if the sentence were offered as the reason, is not available here. This reading would give a the reason for Louise's decision to not attend meetings, i.e. that she chose not to attend because there is a possibility that she is busy. The availability of (ii) but not (i) suggests that *might* has to operate over the causal/inferential relation, not the prejacent itself. This was used as an example of a proffering speech act, taken as distinct from or in addition to assertion.

However, the reason for the absence of the reading in (40ii) is not the consequence of *might* giving rise to a special conventionalized proffering speech act. It seems to be due to the fact that, in this case, the prejacent and the question presupposition ("Louise is not coming to our meetings these days.") are both states holding at the reference time. Since the modal gives possibilities for the prejacent, this means that the modal is operating over possibilities which hold at the time of the prejacent, and in this case that corresponds to the time of the question presupposition. That is, the possibilities given are states with coincide temporally with Louise's state of not coming to meetings. Next we shall examine a case where (i) is available but (ii) is not.

(49)   Q: Why isn't Louise coming to our meetings these days?

    A: She might get yelled at by the boss.

i: Because it is possible that she'll get yelled at

ii: #it is possible that it is because she'll get yelled at.

This gives us the opposite situation we had in (40); the proffering reading, (ii), is not available. In this case, the prejacent is future-oriented and thus future to the reference time. This means that the modal operates over possibilities which may occur in the future of the reference time. This means that the worlds being quantified, the accessible worlds, include worlds where Louise does not skip meetings at the future point of time. Note that if we change "get" to reflect a state, such as by replacing it with "be being" we would instead have reading (i) and not reading (ii).

In the following example, the modal base is ambiguous between containing Speaker's knowledge up to the present time or at the event time of the prejacent.

(50)   Q: Why isn't Louise coming to our meetings these days?

            A: She might've been too busy. [80]

                i: Because it was possible that she would have then been too busy.[81]

                ii: It's possible that it is because she has been too busy.

In this case, we can also get a future-oriented reading as in (ii)[82] or a simultaneous state reading as in (i), such that the modal base includes the knowledge of a past point in time, which can correspond to that of the event time in the question and thus not include the question presupposition. We get the "proffering" reading for (ii) where the modal base includes knowledge up to the assertion time and does include the question presupposition[83]. Again,

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[80] Reading (i) seems much more difficult to get for *may*.

[81] Speaker might follow up with, "She sometimes complains that she always has to be on the lookout for sudden emails from her advisor asking for help."

[82] This reading does not seem to be possible for *must*. Analysis of this will be for future projects, although there is some related investigation in (P Arnaud & Hacquard, 2013).

[83] (40) has only one tense, so it is unambiguous. The modal in (50) can take the event time or the assertion time. This begs the question of why (49) can only take the event time. I do not have an answer at this point but there may be related observations in (Hacquard, 2010).

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this means that the worlds being quantified over, the accessible worlds, include worlds where Louise does not skip meetings.

I propose that the publically explicit inclusion of the question presupposition in the modal base, which is brought about by the addition of it to the common ground and results in all worlds being quantified over be worlds where it is already known that Louise skips meetings, combined with the modal giving possibilities which hold at the reference time is what brings the proffering reading about. In these cases, what Speaker is taken to be asserting is that Louise's being too busy with her dissertation is a stereotypical possibility at the reference time even when the set of accessible worlds are restricted to only include those where she is not attending meetings.

The "proffering" falls out naturally from the meaning of a modal assertion of stereotypical truth at reference time which includes the question presupposition if we make one assumption about how discourse and linking propositions relate: when a modal is used, Hearer is prompted to search for some proposition which can serve as an instantiation of $a'(x)$, and the surrounding discourse is the obvious place to look. This is similar to saying, "Did you hear the thunder? It might be raining." In this case, Hearer assumes that Speaker intends, "It is thundering" as an instantiation of $a'(x)$. Unlike when the possibilities are for a point in time future to the reference time, it is fact that Louise does not attend meetings for reference time possibilities, so this fact can be used as positive evidence (which is pragmatically required to be true to activate a linking proposition), and so Hearer will assume that Speaker intends the question presupposition as at least part of $a'(x)$.

First we will look at the part of the interpretation process of (40) that is common for human possibility and human necessity.

- (Q) adds "Louise is not coming to our meetings these days" to the common ground. Thus, Speaker's modal base is also commonly believed to entail, "Louise is not coming to our meetings these days."

- A human possibility/necessity assertion with respect to a stereotypical ordering source is a proposal for what should be considered a normal state of affairs in the common ground.

- A linking proposition, *if a'(x) then p'(x)*, derived from *usually$_x$ if a'(x) then p'(x)* where 'Louise is too

busy with her dissertation' is an instantiation of $p'(x)$ is necessary to update the possibility configuration of "Louise is too busy with her dissertation." to a stereotypical human possibility with respect to the common context set, so Hearer knows that Speaker believes that there is an instantiation of $a'(x)$ corresponding to the prejacent.

- In this case, the question has made a "question presupposition" salient, which results in Hearer assuming that it factors into Speaker's instantiation of $a'(x)$.

- Speaker's asserted proposition presupposes that Louise has to write a dissertation, so this will also be an element of $a'(x)$.

- If Hearer also accepts that there is such an instantiation of $a'(x)$ which is true, this would mean that a possible world where Louise hasn't been coming to meetings, Louise has to write a dissertation and Louise is too busy with her dissertation to come to meetings in the stereotypical max set.

- Speaker is asserting that the facts that "Louise has not been coming to meetings" and "Louise has to write a dissertation," and possibly other facts privately known to him[84], are positive evidence for "Louise is too busy with her dissertation to attend meetings."

We can observe from the interpretation process that part of the reason it is interpreted as an assertion of a possible answer is because it asserts a stereotypical state of affairs which incorporates the question presupposition as positive evidence. Even in this case, Speaker is not presupposing that the prejacent as true. Speaker is not ruling out, for example, the possibility that Louise is not busy at all. However, the assertion does commit Speaker positively to the prejacent in some manner. I suggest that commitment is that of stereotypical truth, such that there is evidence that the prejacent is likely given that she has a dissertation to write and she is not attending meetings.

If Speaker asserts with *might*, he allows via disconnected branches (p. 68) that there are maximally stereotypical possible worlds in the max set at the reference time where Louise is not too busy with her dissertation

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[84] Hearer has the option of taking Speaker's instantiation of $a'(x)$ as being just the question presupposition and that Louise has a dissertation to write, or to believe that there's more. This decision would be a reflection of whether she believes these two facts are enough to stereotypically entail "Louise is too busy with her dissertation."

to come to meetings; it is only one likely answer among potentially many others. If Speaker asserts with *must*, he asserts that all possible worlds in the stereotypical max set at the assertion time are worlds where Louise is too busy to come to meetings; the prejacent is the only likely/normal/predictable answer at the assertion time.

Next we will take a closer look at how a modal answer and a non-modal answer differ to show the activity of stereotypical human modality in the answer. In the examples below, I have given the non-modal counterparts of the answers in (40) and (50).

(51)   Q Why isn't Louise coming to our meetings these days?

          A She is too busy with her dissertation.

          A': She was too busy with her dissertation.

Unlike with the modal assertions in (40) and (50), Louise's being or having been too busy with her dissertation is presented as known to be true. Like the modal, something like a covert "because," which expresses Speaker's belief of what the answer to the question is, is bound by the assertion time. In both cases, Speaker presents his asserted proposition as the only correct answer, not a possible answer.

This is in contrast to the readings corresponding to reading (ii) above, where the answer seems to be presented as one of stereotypical truth. That is, the answer is presented as a likely answer but there are other possible answers[85]. Thus, it seems that the commitment to the answer is inherited from the commitment expressed by the assertion. In the case of non-modal assertions, this is truth, and in the case of epistemic modals, this is stereotypical truth. Thus, in addition to allowing for a prejacent which takes place at the reference time, another key factor in the ability of modals to function as possible answers is that they express stereotypical human modality, and thus indicate a positive commitment by Speaker to the prejacent. This commitment would not be available if Speaker were only asserting contextual possibility. On the other hand, if he were expressing contextual necessity, he would be presenting the answer as the only answer, equal to (or stronger than) a non-modal assertion.

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[85] In the case of *must* the only alternatives would be unlikely (i.e. slight possibilities)

In summary, in all possible readings of (40), (49), and (50), the prejacent of the modal is proposed as a stereotypical human possibility/necessity, and this takes different relations to the question depending on the temporal orientation of the prejacent. When the prejacent is reference time oriented, the assertion becomes a "modal answer" to the question rather than a "modal possibility" asserted to be the answer. In these cases, since the question presupposition is taken to be part of Speaker's instantiation of $a'(x)$ and that this proposition (among others) licenses this commitment to stereotypical truth translates to the prejacent being presented as a likely answer, separating it from non-modal assertions, which present the asserted proposition as the answer.

In this section, we have seen that the proffering effect can be explained by the relation of the prejacent to the reference time and commitment to the prejacent being a stereotypical human possibility/necessity based on the question presupposition as an element of the instantiation of $a'(x)$. As such, the proffering discourse effect does not constitute evidence for a subjective subtype of epistemic modals or of epistemic modal bases. It does indicate that a key role of human modality assertions is to update the possibility configuration of the prejacent in the common ground.

In this section we saw how the function of epistemic modals to propose updates of their prejacents to human possibility/necessity in the common ground can be described as suggestions of answers to a question if the positive evidence they use in the linking proposition taken in part at least to include the question presupposition. In the next section, we shall reexamine agreement and dissent to see how the availability, or lack thereof, in the common ground of instantiations of $a'(x)$ and $b'(x)$ in the pragmatic presuppositions made by such proposals help shapes interaction between Speaker and Hearer. This connects with Prediction E in 3.4.2.

3.5.2.2 Agreement and dissent

Some researchers analyze subjective modals as being linguistically distinct from objective modals. Lyons (1977) gave them different semantic content, Papafragou (2006) gave them different modal bases by marking subjective modals as indexical and thus having solipsistic modal bases while she marked objective modals as not indexical and thus non-solipsistic. I will show that the difference they are describing with "objective" and

"subjective" is not dependent on how the modal base is derived but on whether the relevant knowledge in the modal base (the instantiations of $a'(x)$ and $b'(x)$) is perceived to be in the common ground or not, as per prediction E.

Observations concerning agreement and dissent are a principle motivation for the division of modal assertions into objective and subjective subtypes, so we they will be the next object of examination. Examining assertions in terms of the common ground of the discourse event they are made in allows a better depiction of what options are available to Hearer and why.

(31)   a: Max must be lonely.   *(Subjective; based on Speaker's private knowledge)*

         b: That's not true. / I agree. / Are you sure?

(32)   a: The victim must have known the killer. *(Objective; based on publically available evidence)*

         b: That's not true. / I agree. / Are you sure?

Papafragou and Lyons claim that in the case of subjective modals, Hearer cannot respond directly to the modal assertion. Papafragou suggests that when Hearer agrees as in (31b) she is addressing the prejacent rather the modal claim. Portner also discusses the issue, and claims that Hearer can address either, but when she addresses the modal claim she does so based on her own solipsistic assessment. They all concur that Hearer can argue and agree with the modal claim in the case of objective modals.

Given the pragmatic presuppositional approach, there is no difference in the mechanism behind subjective and objective modals. For (31a) to update the possibility configuration of its prejacent, Speaker must believe $\exists a,a',p'$: *a is true & usually if $a'(x)$ then $p'(x)$* where *Max is lonely* is an instantiation of *p'(x)*. For (32a), Speaker must believe $\exists a,a',p'$: *a is true & usually if $a'(x)$ then $p'(x)$* where *the victim knew the killer* is an instantiation of *p'(x)*. We can account for the intuitive differences in subjectivity and objectivity with Prediction E.2 (=Depending on whether the relevant beliefs are in the common ground or in Hearer's private knowledge, Hearer can have different reactions to Speaker's assertion.).

The intuitive difference between them is just a manifestation of the degree of perceived overlap between the common ground and the modal base. In (31), since it is relative only Speaker's private knowledge, there is no information which is saliently established as relative to the modal assertion prior to the utterance, so Hearer can only guess at what Speaker's intended instantiation of *a'(x)* is. In the case of (32), Hearer must guess as well at what Speaker's intended instantiation of *a'(x)* is, but since they are at a crime scene and it is common ground that there is evidence that has been gathered, she can guess confidently. In either case, agreeing would indicate that Hearer has found a proposition suitable to be the situation-specific instantiation of *a'(x)*. For (31), whatever content Hearer found for the instantiation of *a'(x)* is likely to be different from Speaker's since, presumably, they know different things about Max. As onlookers, this results in Hearer's agreement to (31a) seeming to correspond less directly to Speaker's assertion. For (32), it is likely to be the same since the evidence available is the same for both Speaker and Hearer. This results in Hearer's agreement seeming to correspond closely to Speaker's assertion.

In terms of disagreement, human necessity assertions provide Hearer with multiple options. Hearer can disagree by asserting that the prejacent is false, by rejecting the existence of positive evidence, (i.e. the existence of a suitable *a*), which would make the prejacent a slight possibility, or by rejecting the second presupposition, $\neg \exists b, b', p'$: *b is true & usually if b'(x) then $\neg p'(x)$*, which would result in there being more than one likely candidate for the culprit or more than one state of mind Max could be in in the common ground. The first and second option may feel like a reaction to the prejacent to many onlookers since they result in the prejacent being impossible or slightly possible. The second would likely feel like a rejection of the modal assertion. In fact, all three cases are expected given that Hearer is reacting to the pragmatic presuppositions produced by a human necessity assertion.

Though it is probably very rare in actual discourse, if Hearer does not have an idea of what Speaker's intended instantiation of *a'(x)* is, as we are supposing, it would be difficult to take the second option confidently. This is probably what leads to the intuition that Hearer cannot reject a subjective modal assertion. Picture a garrulous schoolgirl saying (31) as she gabs about her crush, Max, to an indifferent classmate. When she asserts

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(31) the indifferent classmate will accept her assertion on a general level: "Speaker has some reason she thinks Max being lonely is a likely state of affairs."

Next we will imagine a situation where Hearer might also have some interest in the status of the prejacent. Imagine that Max is Speaker's brother, and Speaker asserts (31) when he is talking to another family member (Hearer). Even if Speaker does not make clear what she intends *a* to be, Hearer is likely to have an opinion.

(52)   Really? He seemed happy last time I saw him yesterday. He might have just had a stomachache when you saw him.

In this case, as *just* makes clear, having a stomachache is intended as complementary to being lonely. Thus, Hearer has raised positive evidence for $\neg p^{86}$, and Speaker's claim of stereotypical necessity is challenged. This means that minimally $\neg \exists b,b',p'$: *b is true & usually if b'(x) then ¬p'(x)* is not accepted into the common ground, but $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x)* is not rejected. That is, Hearer may still accept that it is a human possibility that Sam is lonely without changing her mind, but not a human necessity[87].

This shows us that a tendency for Hearer not to reject "subjective" assertions, i.e. assertions where Speaker's intended instantiation of *a'(x)* cannot be inferred from the common ground, is a manifestation of her lacking sufficient information to infer what *a'(x)* is, that is, it is a reflection of her perception of the common ground's relation to the modal base. Even in such a case, Hearer can reject a human necessity claim if she has some knowledge and interest in the prejacent by rejecting Speaker's presupposition that there is no positive evidence for the stereotypical truth of the prejacent's complement, as in the case of Max's family above. Hearer

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[86] More precisely, Hearer has provided an epistemic possibility assertion as a counterargument, so Speaker must evaluate whether to accept that Max having a stomachache is a human possibility before it can function as a counterargument. Formally, Hearer's counterargument would look something like: $\exists c,c',b,b',p'$: *c is true & usually if c'(x) then b'(x) & if b'(x) then ¬p'(x)*. In this case, since what is needed to activate the logical link is the truth of c, the b in a shortened "usually if b then ¬p" corresponds to c in the fully fleshed-out inference chain.

[87] This dialogue would likely continue until Speaker and Hearer agreed on the possibility configuration of "Max is lonely." The dynamics of such interaction will be the topic of the next chapter.

can also reject a possibility claim if she has evidence that the prejacent's complement is a contextual necessity, as we saw in (30).

This explanation gives a unified description of what happens during dissent and agreement. We do not need to suppose different mechanisms for different types of modal bases. All modal bases are solipsistic, but some coincide with the common ground in terms of relevant knowledge more than others. Even in the case of the crime scene, there is no guarantee that Speaker is relying solely on evidence from the crime scene. He may well secretly have knowledge about the murdered person which Hearer does not. In the end, Hearer has to infer what Speaker is using as his instantiation of $a'(x)$. The degree of confidence she can have is a function of the common ground in relation to the prejacent.

Lastly, Portner observes that "Are you sure?" is the response that most clearly targets the prejacent among the agreement/dissent examples. I would suggest that the intuition that this response is isolating the prejacent originates from the fact that the only upgrade from human necessity is contextual necessity, which entails truth. In general, what someone is looking for when they ask "Are you sure?" is for Speaker to make the degree of his confidence in whatever the content was that he asserted. This applies equally to responses to non-modal as well as necessity/possibility assertions. Consider the following.

(a) Max is lonely.   --   Are you sure? -- Yeah, his girlfriend left the country.

(b) Max must be lonely.   Are you sure? -- Yeah, he must be. His girlfriend left the country.

(c) Must might be lonely.   Are you sure? -- Yeah, he might be, his girlfriend left the country.

The felicity of using a modal assertion in response to "Are you sure?" is already proof that it does not necessarily target the prejacent. But this does not mean that it cannot.   Recall that in the case of human modality, justification, i.e. a semantically true instantiation of $a'(x)$, is entailed by the pragmatic presupposition.

In the case of possibility operators, *may* is semantically ambiguous between contextual possibility which typically does not require positive evidence/justification, and human possibility which does. In responding to

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"Are you sure?" with a positive affirmation, Speaker is affirming that he intends the strong meaning, and providing evidence is a way to justify this intended meaning. On the other hand, if Speaker replied that he wasn't, this would not imply that he doesn't think that "Max is lonely" is contextually possible, it results in it remaining a contextual possibility, ambiguous between Configuration 3 and 5.

In the case of necessity operators, *must* is semantically ambiguous between human necessity and contextual necessity, both of which require positive evidence. In responding to "Are you sure?" with a positive affirmation, Speaker will often be taken to be intending contextual necessity, which entails that Speaker believes the prejacent is true. This could easily be mistaken for Hearer asking if the prejacent itself is true or not, but the fact that *might* does not have this reading is evidence against that analysis. Additionally, a negative reply does not entail that Speaker believes the prejacent is false. A negative reply will result in confirming that he did not intend a contextual necessity, similar to the example we saw in section 2.1.2, where Jane admitted that Bob's going to the store was a contextual possibility while maintaining that his going to the office was a human necessity.

In this way, even "Are you sure?" seems to target not the prejacent itself, but the pragmatic presuppositions which are derived from the modal proposition. This allows Hearer to confirm whether or not he is justified in making a human modality claim, to ask what it is, or to confirm how strong the evidence is. This is all part of a process of settling on a single Possibility Configuration for the common ground.

In this section we have seen that the presuppositional approach allows us to make explicit what Hearer can agree with, disagree with and question. We saw that a situation-general pragmatic presupposition is always available, and when Hearer does not have enough information to infer the situation-specific content, she has to base her counterarguments on the general claim. This results in her responses seeming less closely connected to Speaker's assertion than in the case when she could identify what Speaker was intending as an instantiation of $a'(x)$. Given this, it seems that what the subjective/objective labeling in Lyons (1977), Papafragou (2006) and Portner (2009) is capturing is the state of the common ground in relation to the prejacent, which interacts with but is ultimately external to the proposition asserted by epistemic modals.

3.5.2.3 Embeddability

Next we will observe some embedding facts which were used in support of the objective and subjective divide by Papafragou (2006). Our goal is to show that delimiting embedding facts based on modal base properties is problematic, but that they can be defined rather neatly by how they relate to the common ground.

Specifically, we will show that the infelicity or felicity of epistemic modal assertions are at least in part a function of whether the common ground and the solipsistic/subjective modal base of the modal assertion are perceived to overlap in terms of propositions which are relevant to the Possibility Configuration of the prejacent (i.e. propositions which activate linking propositions). This adjustment of assumptions will allow us to make predictions of felicitous and infelicitous embedding based on common ground configurations.

(37) ?It is surprising that Superman must be jealous of Lois.   (subjective reading)

(38) It is surprising that the victim must have known the killer.   (objective reading)

Since assertions are primarily attempts to add the matrix proposition to the common ground, the embedded propositions in second-order predicates such as *believe*, *surprised that*, *wish that*, etc. are not asserted and thus are assumed to not need evaluation[88]. In the case of factive predicates, the embedded proposition is presupposed to be fact and as such not in need of evaluation. Thus, it is reasonable to suppose that for an assertion of a factive predicate to be felicitous, if the embedded proposition is not already common ground, Speaker must believe that Hearer can and will accommodate it.

In the case of (37), Hearer must accommodate, "Speaker believes the fact that Superman must be jealous of Lois is common ground." We defined what it means for a human modality proposition to be common ground in 3.3.2. For a proposition p to be a human necessity relative to the common context set, $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x)* and $\neg\exists b,b',p'$: *b is true & usually if b'(x) then ¬p(x)* must be common ground. Since we are assuming that the truth

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[88] There are second ordering predicates called assertives which specialize in proposing their embedded proposition for the common ground (e..g. "claim/argue that") and veridical predicates such "be right/correct that..." which propose the addition of matrix content and the content of its embedded clause (Arnaud et al., 2014). Here we focus on doxastic predicates.

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of (37) is relative only to Speaker's knowledge, and Hearer does not know the contents of Speaker's knowledge nor have access to any common ground that could compose Speaker's relevant knowledge, we are effectively creating a common ground with respect to which Speaker cannot expect Hearer to be able to accommodate the above two propositions and where Hearer would not believe Speaker believes she is able to accommodate them.

Compare this to the case of (38), where Speaker's modal evaluation is ostensibly dependent on clues at the crime scene. Because the other discourse members also have access to the information on the crime scene, if Speaker is confident in his inference he can believe that the others have also arrived at the same conclusion as him. If Speaker utters (38), Hearer will be aware of this, and be able to accommodate the two required propositions above. Then she can evaluate whether or not it would be surprising for him given whatever his belief state was prior to coming to believe $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x) where 'the culprit knew the victim' is an instantiation of* $p'(x)$ and $\neg \exists b,b',p'$: *b is true & usually if b'(x) then $\neg p'(x)$ where 'the culprit knew the victim' is an instantiation of* $p'(x)$. If we change the common ground but keep the rest constant, for instance if we picture Speaker asserting (38) to his wife who does not have access to the crime scene, it is just as awkward as (37).

The fact that a "subjective" *must* assertion, i.e. one which uses knowledge that Hearer does not believe to be in the common ground, cannot be embedded is not a characteristic particular to modal sentences or a symptom brought on by a certain type of modal base, it is the manifestation of a general principle which acts on presupposed propositions which trigger their own presuppositions. For instance, the verb phrase "John left the party" presupposes that John was at the party at some point. If Hearer doesn't know John came in the first place or that he would have any reason to come, it would be inappropriate to say, "I was surprised that John left" to her. On the other hand, similar to having common ground access to crime scene evidence, even if it is not common ground that John came to the party, if it is common ground that he often goes to parties, then Hearer will know that Speaker believes she will accommodate the presupposition of the embedded proposition.

We can alleviate the problem with (37) by making it common ground that Speaker is presupposing that Superman must be jealous of Lois. In the next example, we have the modal proposition asserted explicitly, but maintain that whatever relevant knowledge Speaker has is not common ground.

(53)   "Clark Kent must be jealous of Lois."

"Really? But he's Superman."

"Yeah. I was surprised that Superman[89] must be jealous of Lois."

In this case, Speaker first asserts that Clark Kent is jealous of Lois. In other words, he pragmatically presupposes that $\exists a,a',p'$: *a is true & usually if a'(x) then p'(x)* and $\neg\exists b,b',p'$: *b is true & usually if b'(x) then ¬p(x)*. Hearer questions the veracity of Speaker's assertion by posing a challenge to $\neg\exists b,b',p'$: *b is true & usually if b'(x) then ¬p'(x)*. Whether Speaker can identify why she is objecting or not is a matter of the common ground, but Hearer's intended stereotypical trend could be "if a person x is great and a person y is ordinary, then x is not jealous of y" and her instantiation could be "if superman is great and Lois is ordinary, then Superman is not jealous of Lois." where both "Superman is great" and "Lois is ordinary" are true.

Next, Speaker's "Yeah" accepts Hearer's asserted proposition, that Clark Kent is Superman, and indicates that it does not contradict $\neg\exists b,b',p'$: *b is true and usually b'(x) is true & if b'(x) then ¬p'(x)* by taking it for granted in his emotive predicate assertion. At this point, whether or not Hearer's private beliefs have changed, it is apparent that Speaker is operating on the belief that both of the propositions needed to make "Superman is jealous of Lois" a human necessity relative to the common context set are common ground. Regardless of whether or not Speaker uses publically available information to make his first assertion, the embedded modal in his second assertion is felicitous. In order to explain this, we must have a theory which can explain how a "subjective" modal might be accepted into the common ground. This is explained by the situation-general presuppositions systemically produced by the combination of the quantity-quality maxim, the common ground, and the semantics of human modality.

Thus we can see that there is no essential difference in the modal base depending on the nature (public or not-public) of Speaker's basis for making an assertion. Rather, the assertion gives a more subjective or more

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[89] I have changed the subject in the first and second instance of the modal proposition to avoid the infelicity of repeating previously uttered information in discourse.

objective impression depending on the degree to which the relevant information is perceived to be available in the common ground. This is the active factor in determining whether Speaker can treat a modal proposition as common ground or not, which is necessary for felicitous embedding under most factive predicates[90].

3.5.2.4 What is the commitment made by a human possibility assertion?

In section 2.1 we saw that neither the CPS in (Portner, 2009) nor the cloud of contexts in (von Fintel & Gillies, 2011) provides a way to account for the positive commitment by Speaker. In (Portner, 2009)'s CPS, modal assertions result in asserting that the prejacent is possible on the one hand, and insert it in a shared proposition space (CPS) to which Speaker and Hearer are interested but not committed on the other. However, we saw that Speaker seems to be positively committed to the prejacent. As we observed in 3.2.2.4, the CPS failed to account for Speaker's commitment toward the prejacent.

There was a similar problem in the cloud of contexts framework in (von Fintel & Gillies, 2011). Modal assertions float a set of contexts from which Hearer chooses one for evaluation purposes, but Speaker need only be committed to the reading which is relative to a solipsistic modal base. Since Speaker is not committed to the intersubjective modal base, it is odd for Hearer to "agree" with it, and it also does not predict that she would defend herself. An additional empirical inadequacy we observed was its inability to account for responses which indicated agreement while expecting that what relevant knowledge Speaker has is different from hers.

In this section, I will show how the presuppositional framework presented in this dissertation, wherein Speaker's modal assertion results in committing himself to non-modal pragmatic presuppositions in the common ground, does result in discourse pressure on Hearer to present evidence if she rejects Speaker's proposal. I will also show how the varied range of responses Hearer can make in response to a possibility assertion fall out naturally from the effects of an epistemic modal assertion interpreted as being in accordance with the quantity-quality maxim.

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[90] One might point out that "I know that Superman must be jealous of Lois" is felicitous even if the prejacent isn't common ground even though *know* is a factive predicate. However, for it to be felicitous in such a case, *know* must be interpreted like an assertive predicate, which means that Speaker is arguing that the prejacent should be true in the common ground. Therefore, this does not constitute a counterexample to the argument developed here.

This is because it allows us to maintain that assertions are a result of the presupposition that discourse participants have different knowledge which they are disposed to make increasingly common, rather than assert that their knowledge is common to begin with, as in the intersubjective modal base approach.

Alex is aiding Billy in the search for her keys.

(33)   a: (Alex=female) You might have left them in the car.

            b: (Billy) You're right. Let me check.

            b': (Billy) No, I still had them when we came into the house.

Alex's first assertion results in *∃a: a is true & usually if a then p* and *∃b,b',p': b is at least contextually possible & usually if b'(x) then ¬p'(x)* being presupposed. In effect, Alex commits himself to the first. Since this commitment is non-modal and therefore its truth is not bound to the confines Speaker's knowledge, Hearer can evaluate it as she would any other assertion. In most discourse, participants will reflexively reject proposals they know are false, perhaps to prevent the common ground from deteriorating[91].

In the case of (b'), it is added to the common ground that Billy believes that Alex's commitment is incorrect. For (b') to be accepted, Alex has to retract his commitment. There is a general discourse pressure, not restricted to modals, for a participant to present evidence when they contradict a public commitment of another participant. Billy is claiming that *p* is either slightly possible or contextually impossible, though she does not make it clear which. This is contrary to Alex's assertion and its truth may be disagreeable to him. Thus, she gives her evidence to circumvent counterarguments. This is a manifestation of Prediction F(=(xvii), i.e. Speaker's assumption that Hearer will accommodate his pragmatic presupposition, can lose validity if the human possibility of the prejacent is disagreeable or surprising to Hearer. When Speaker believes this is the case, he will be more likely to make the situation-specific content of his instantiation of *a'(x)* explicit and Hearer will be more likely to present evidence for the prejacent's complement (i.e. an instantiation of *b'(x)*.) from 3.4.2.

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[91] This reflexive reaction is an empirical fact, and the goal is a theoretical motivation for the fact which is reasonable but not proven.

In the case of (b), Billy is agreeing with Alex. We noted before that this is informative enough to encourage her to go and check the car, but not enough for her to fully believe that the keys are there. Both of these observations fall out naturally if we interpret Alex's assertion as one of human possibility, so that there is it is one possible normal state of affairs in which the keys are in the car. By accepting it, Billy also accepts the keys being in the car as a likely state of affairs. Next let us examine the three variations of response the other frameworks could not address.

(34)   (Billy) I hadn't thought of that. You're right.

(35)   (Billy) Hm, maybe. What makes you say that?

(36)   (Billy) You're right, but what made you say that?

The explanation for all of these responses fall out easily from the current framework, as per Prediction (E.1). (34) is Billy admitting that it hadn't occurred to her that the keys being in the car was a likely state of affairs. In (35) she is not sure if she wants to accept the assertion but is tempted to, and so asks for confirmation of what Alex's evidence a is. In (36), Billy suggests that she had already considered it a likely state of affairs, i.e. that she had an instantiation of $a'(x)$ already in mind, but is surprised that Alex also had one too and asks what it is, perhaps because she didn't think Alex was aware of whatever such propositions she has an mind (perhaps she had secretly snuck out to the car when Alex wasn't looking and suspects she might have left her keys when she did).

This approach, by posing possibility assertions as objective proposals for the prejacent to be a human possibility relative to the common context set can thus explain the presence of informativity and commitment in modal possibility assertions. Speaker is committed to a stereotypical entailment of the prejacent by some fact of the current situation, i.e. $\exists a,a',p'$: a is true & usually if a'(x) then p'(x). This commitment naturally lends itself to committing oneself to the prejacent in a positive fashion. If Hearer makes an assertion which contradicts this commitment, it is natural that she would feel a need to support her claim. If Hearer accepts the proposition to which Speaker is committed, it is natural that it would be enough to motivate her to take action.

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3.5.3 Section conclusion

We started with an observation that epistemic modals are not relative to all the knowledge in the world, that they are subjective. We then noticed that sometimes the truth conditions seem to be stricter than they would be if they were entirely based on Speaker's knowledge. In this section, I have shown that by factoring in the quantity maxim before fixing the truth conditions, we can address this without supposing non-solipsistic modal bases. There are demands on what the modal base and ordering source must contain in order for a modal assertion to be informative, and the sentence Speaker formulates expresses a proposition which meets these demands. Our truth judgments are also relative to a proposition which meets these needs.

This also allows us to explain the observations which motivated the subjective/objective dichotomy. We have accounted for the presence of a positive commitment by Speaker in making epistemic modality assertions through the use of general stereotypical trends. The proposal that "there is an instantiation of a stereotypical trend entailing the prejacent" gives Hearer something to agree and disagree with, and also a reason to justify herself if she gives a negative reaction. We can also account for the intuitive differences in objective and subjective modal assertions. When Hearer believes Speaker's intended instantiation of $a'(x)$ is common ground she can identify it and refer to it specifically, and this leads to us identifying the modal as objective. When she cannot identify it, she can only address the situation-general presupposition which, in the case of agreement involves finding a likely instantiation of $a'(x)$ based on her own knowledge and stereotypical trends that she knows, and in the case of disagreement of finding an instantiation of $b'(x)$ which is true, which would give evidence for the complement of Speaker's prejacent. This leads us to identify her response as being her own subjective assessment. The state of the common ground was also an active factor in making certain utterances seem infelicitous when embedded under factive predicates.

We also determined that the proffering speech act was just an instance of assertion of a modal proposition whose prejacent was reference time oriented so that the question presupposition and the possibilities operated over by the modal are simultaneous. In making an assertion, Speaker commits himself to the prejacent as a likely possibility/necessity, and this commitment can be interpreted as his confidence in the prejacent as an answer to the

question.

3.6 Chapter summary

We started the chapter by observing that modal assertions, given Kratzer's semantics, would seem to violate the quantity maxim derived from the Cooperative Principle. We framed this problem in Stalnaker's discourse model, and saw that since both possibility and necessity assertions are relative to Speaker's internal knowledge, they should not entail any sort of 1st-order belief update for the common ground. However, observationally, as we saw, they do. We labeled this as Level 1 acceptance, and set out to identify it.

We succeeded in doing this by adjusting our treatment of the truth conditions of modal propositions. We determined that the truth conditions that are relevant for a discourse-situated modal proposition are those pertaining to a proposition that can contribute to the common ground. We saw that modal propositions partially indicate the Possibility Configuration intended by Speaker, and that they can be proposals to update the Possibility Configuration of their prejacent with respect to the context set. We then determined that the Possibility Configuration can be changed when a linking proposition, hedged or not, and its antecedent are present in the common ground. We then bridged the gap between a Speaker's private knowledge and the common ground by showing that Speaker can presuppose that the antecedent of such a linking proposition is true, thus prompting accommodation by Hearer.

We determined the identity of Level 0 acceptance to be accommodation of pragmatic presuppositions which are systematically produced by modal assertions. This portrayal of Level 0 allowed us to explain truth conditional judgments, the proffering speech act effect, embeddability conditions for factive predicates, the object of agreement and dissent and the type of commitment made by modal assertions. This also allows us to give a very succinct description of the difference between the two assertions below, which we started this chapter with.

(19) It may be raining in South Africa.

(21) It may have snowed in Tokyo this July.

In (19), Hearer could not believe that Speaker believed the pragmatic presuppositions that would be necessary to make an informative assertion, i.e. that he had some positive evidence for "it's raining in South Africa" being a normal/predictable state of affairs. In (21), Hearer could believe that Speaker had such positive evidence, and thus it could be interpreted as an informative utterance. Though both assertions were random and of little interest to Hearer, the state of the common ground allowed (21) to meet a minimal quantity demand but not (19). This is an instance of the observation that the interpretation of any utterance must be analyzed with all three components of the tripartite system in mind: grammar, the common ground, and the CP.

In the next chapter, I will show how this doubly-relative modal semantics paired with the quality-quantity maxim allows us to explore a whole new dimension of discourse interaction. In formal discourse, much effort has been put into uncovering how to settle an issue in terms of yes and no. But there are also times when yes and no is untenable, and in these cases rather than yes or no, we have our five possibility configurations. Discourse events involving modals often revolve around settling on a possibility configuration for the common ground.

Chapter 4 May/might and must as "modal issue"-raisers in discourse events

Through Chapters 1 to 3, I have endeavored to show that stereotypical human modality allows Speaker to express a positive commitment to the prejacent which differs from a commitment to its truth. The fact that this commitment is not a commitment to the proposition's truth may be responsible for leading researchers over the years to liken modals to questions.

For instance, Lyons said, "..subjectively modalized utterances, unlike categorical assertions and objectively modalized statements, are not acts of telling; and [...] their illocutionary force is in this respect similar to that of questions, which are also non-factive." In referring to modals as non-factive, Lyons points to the fact that the truth status of the embedded proposition is not known by Speaker. Since this implies that the truth status of neither the proposition in question nor its complement is settled, it intrinsically brings both into the realm of discussion.

In this sense, modals resemble polar questions: they both raise an "issue" which features a proposition that is not known to be either true or false. Portner's (2009) CPS is a formalization of this idea. It attributes modal assertions with the function of putting their prejacents on the discourse table without committing to their truth values. This, like a polar question, would make determining a truth value for the prejacent a priority in the discourse event.

However, modal assertions are different from polar questions because they do express a positive commitment by Speaker toward the prejacent and not toward its complement. It is a commitment to the stereotypical truth of the prejacent, i.e. that there is an accessible world where it is true in the stereotypical max set, which entails that it is a human possibility and can mean that it is a human necessity if there is no evidence for its complement. Given the different nature of the commitment, the issue it raises in discourse is also different form that of a non-modal assertion.

While a non-modal issue can be settled by deciding on the truth or falsity of a proposition in the common ground, a modal issue has more ways of being settled: the prejacent can be determined to be in one of 5 different Possibility Configurations. When the discourse participants have high stakes in the status of the prejacent, it will

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typically be necessary to decide on a specific Possibility Configuration. When they do not, just knowing that the proposition is a human possibility will typically be sufficient. This process is mediated by the pragmatic propositions that were introduced in 3.3.4-5.

In this chapter, I will show a variety of examples of how this process can proceed. We will see that once a modal issue has been raised, the Possibility Configuration can be changed and settled on in a way contrary to Speaker's original proposal even without introducing new modal expressions by contradicting and adding new commitments which affirm or reject the pragmatic presuppositions which are entailed by a human modality/necessity assertion. The fact that the process of settling modal issues proceeds just as if the pragmatic presuppositions I have proposed were present as Speaker commitments will give further corroboration for their social reality from the perspective of the discourse process.

4.1 Modeling a discourse event

The object of this chapter is to characterize the deliberation process instigated by modal assertions by which the final common ground is settled on. A modal assertion can serve to refine a contextual possibility to human possibility/necessity, or it may instigate clarification, agreement or disagreement by other discourse participants. In all cases, it raises a modal issue which is resolved when all discourse participants decide on a Possibility Configuration, or in some cases a constrained set of Possibility Configurations, for the common ground.

In order to make this process more visible, I will borrow the discourse framework proposed in (Farkas & Bruce, 2009), which was designed to compare the effects of (non-modal) assertions and (non-modal) polar questions on discourse. It uses Stalnaker's common ground but accounts for more details of discourse by including a table of issues, or questions under discussion, a set of public discourse commitments for each discourse member, and a projected common ground reflecting any non-common discourse commitments. The motivation for incorporating these components is to account for segments of discourse during which participants deliberate over what parts of which proposals should be added to the common ground. This is also the segment of discourse with which this chapter is concerned.

The Table represents issues raised by utterances in discourse. An assertion adds its syntactic material and its denotation to the Table. For instance, "John is at home" would result in "John is at home[D]; {q}" being added to the table. The left side represents the syntactic form of the assertion. [D] is an indicator for sentence type, which is declarative. The syntactic material is preserved on the Table because it influences how Hearer responds; for instance, it is used to account for ellipsis in proceeding utterances. In addition to this addition to the Table, an assertion also results in adding the denotation of the asserted proposition to Speaker's set of discourse commitments.

In section 3.1.2, I showed that when a Speaker asserts a proposition p it is automatically added to the common ground that "Speaker believes p." This was a manifestation of the quality maxim, by which it is common belief that an individual asserts only what he believes. This is part of what motivates Hearer to evaluate his assertion for addition to the common ground. In Farkas & Bruce's framework, this is represented by adding p to a set of discourse commitments DC_x where x is Speaker. Thus an assertion of a proposition p, "John is at home," results in DCx being updated to $DCx \cup \{p\}$.

Speaker, in making his commitment apparent, also projects a set of common grounds, which correspond to how he intends for the common ground to be settled.. What is directly affected by Speaker's assertion is not the common ground itself, s, (except for adding his commitment) but the set of projected common grounds, ps. Thus, an assertion of "John is at home" results in ps being updated to $ps \cup \{p\}$. In the case of a non-modal assertion, only one common ground is projected so ps is a singleton set.

In the case of a question such as "Is John at home?", "John is at home[I]; {p, $\neg p$}" would be added to the Table, where [I] is a marker of the interrogative sentence type, but nothing would be added to DC_x. There would be two projected common grounds: $ps= \{ s \cup \{p\}, s \cup \{\neg p\}\}$. Note that the projected set of common grounds serves as a diagnostic of the state of the discourse commitments and the Table and is not directly used to update the actual common ground. Its usefulness will be more apparent when we look at an example where Speaker and Hearer have contradicting commitments.

In sum, the set of the above information, including the Table, DCx, s, and ps, is referred to as the discourse context K. The state of the discourse context can be represented using tables such as below, where K$_1$ is the starting

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discourse context, K_2 is the one following the assertion of "John is at home," and K_2' follows K_1 after a question of, "Is John at home?".   "A" refers to Speaker and "B" to Hearer.

Figure 5 K_1: Initial discourse context

DC_A	Table	DC_B
Common Ground s_1	**Projected Set** $ps_1 = \{s_1\}$	

Figure 6 K_2: A asserted "John is at home."

DC_A	Table	DC_B
p	John is at home[D]; {p}	
Common Ground $s_2=s_1$	**Projected Set** $ps_2 = \{\ s_2 \cup \{p\}\ \}$	

Figure 7 K_2: A asked "Is John at home?"

DC_A	Table	DC_B
	John is at home[I]; {p, ¬p}	
Common Ground $s_2=s_1$	**Projected Set** $ps_2 = \{\ s_2 \cup \{p\}, s_2 \cup \{¬p\}\ \}$	

When an item is on the top of the table, such as *John is at home[D]; {p}* in Figure 6, it poses an issue to be resolved and the discourse proceeds in a way such as to settle the issue and thus remove the item from the Table. In response to assertions, the canonical way of doing this is to accept the assertion. If B accepts the assertion, *p* is added to B's discourse commitments. Thus, DC_B is updated to $DC_B \cup \{p\}$. Once all discourse members accept *p* so that it is added to all of their discourse commitments, it is then added the common ground and removed from the Table and the individual discourse commitment lists. That is, only those discourse commitments which are not

in the common ground are in DC_x.

In portraying the direction of discourse, they write, "We assume that two fundamental engines that drive conversations are the need to increase the common ground and the need to reach a stable state. The former drives participants to place items on the Table; the latter drives them to take the necessary steps to remove these items in such a way as to increase the cg" (Fargas & Bruce, p. 5). An item on the Table can be removed when a discourse state is reached where the issue is decided. Any item on the table will be either a proposition $\{p\}$, as in the case of non-modal assertions, or a set consisting of a proposition and its complement $\{ p, \neg p \}$ as in the case of a non-modal polar question. For any given item on the Table, that item is settled if its truth value is added to the common ground. Thus, for any issue $\{p\}$ or $\{ p, \neg p \}$, the issue will be settled if the common ground comes to entail p or $\neg p$.

If Hearer rejects a Speaker assertion p, $\neg p$ is added to the Table and to DC_B, Hearer's set of discourse commitments. Since p and $\neg p$ are inconsistent, the two projected common grounds are both inconsistent, meaning they would produce an empty context set. This information is reflected in Figure 8.

Figure 8 K_3: B rejected "John is at home."

DC_A	Table	DC_B
p	John is at home[D]; {p} John is not home[D]; {¬p}	¬p
Common Ground $s_3=s_2$	**Projected Set** $ps_3 = \{ (\{s_3 \cup \{p\}) \cup \{\neg p\}\}$	

When there is no consistent projected common ground, as in K_3, the conversation is "in crisis" and either A or B has to retract their commitment before the Table can be cleared. The projected set is calculated by the information in the discourse commitment lists and the Table. If A or B retracts a commitment, the projected set will be recalculated to exclude the retracted commitment. In this way, it serves as a diagnostic, but not as an active ingredient in determining the common ground.

To review, this model expresses what I have been calling second order beliefs in the common ground as discourse commitments. It uses a projected set to show the state of the negotiation before the actual common ground is updated. When a discourse commitment is common to all discourse members, it is added to the common ground and the corresponding issue is removed from the Table. When all items are removed from the Table, the context state is "stable."

When there are contradictory discourse commitments, participants must decide on which one to accept before the issue can be removed from the table and a stable discourse context can be attained. Another option is to "agree to disagree" in which case an item is removed from the Table along with the projected set it gave rise to without making any changes to the common ground. In the next section, we will use this model to examine modal issues.

4.2 Modal issues

A **modal issue** shall refer to a set of issues which are placed on the Table by means of uttering a modal assertion. Given any proposition which is no more than contextually possible with respect to the context set, it will be possible to elaborate on its possibility configuration through discourse. A modal issue will be raised by a modal assertion, and resolved by constraining the Possibility Configuration for the prejacent as much as possible given the beliefs of each participant of the discourse event which they are willing to make public. There can be cases where discourse participants simply lack the beliefs necessary to settle the issue, or where completely settling the issue is not required by the discourse goal.

Since a Possibility Configuration defines the relation of both a proposition p and its complement $\neg p$ with the relevant set of worlds (i.e. a pair of epistemically accessible worlds and a max set, or a context set), a modal issue puts an item on the Table for each p and $\neg p$. I have repeated the table of Possibility Configurations below for reference in the coming sections.

Table 2 The possibility configurations of doubly-relative modality

	Contextually Impossible	Contextually Possible	Slightly Possible	Humanly Possible	Humanly Necessary	Contextually Necessary
	must$_c$ not	may$_c$		may$_h$	must$_h$	must$_c$
1	p	¬p		¬p	¬p	¬p
2	¬p	p		p	p	p
3		¬p , p	¬p	p	p	
4		¬p , p	p	¬p	¬p	
5		¬p , p		¬p , p		

4.2.1 General acceptance

I will start with a simple exposition of "general acceptance." This was mentioned in Prediction C in section 3.4.2: when Hearer has no contrary beliefs and also trusts that Speaker is in a position to have the relevant knowledge, acceptance at the most general level will occur. This means that Speaker accepts that there is some instance of the antecedent of a linking proposition that is true. We will consider two examples from Willer (2013), and compare some of the differences between his approach and that of this dissertation. The first will be a possibility assertion and the second will be a necessity assertion.

(54)   Mary: I can't find John. Do you know where he is?

         Alex: He might be at home.

         Mary: Oh, OK, I'll call him and check.

In this situation, Mary does not know where John is, and so it is presumably contextually possible for her that he is at home. And yet, Alex's assertion persuades Mary to call and see if John is home, indicating that she did gain some information from Alex's assertion.

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Willer (2013) suggests that what "might" does is "change possibilities that are merely compatible with the agent's evidence into "live possibilities"--possibilities that are compatible with the agent's evidence and that the agent takes seriously in inquiry."

My proposal models this as updating the prejacent from 'no more than a contextual possibility' to a human possibility. Additionally, as we shall see, it can pose a "modal issue" which is settled by constricting the possible Possibility Configurations for the prejacent relative to the context set. Intuitively, a human possibility and a live possibility capture very similar intuitions, but aside from my approach being truth-conditional and Willer's being non-truth conditional, there are significant differences in the details which are captured. These will be discussed after I have shown how my model can account for the above exchange.

Figure 9 K_1: Alex asserts, "John might be at home."

DC_{Mary}	Table	DC_{Alex}
	John might be at home; {p}	p
Common Ground $s_1=s_2$	**Projected Set** $ps_2 = \{s_2 \cup \{p\}\}$	

Alex's answer is a response to Mary's question. We shall take this for granted and assume that Mary's question about John's whereabouts has been cleared from the Table in exchange for the modal issue raised by John's assertion[92,93]. John's asserted proposition is an epistemic modal whose modal base contains John's knowledge, so acceptance of it does not semantically require Mary to change her beliefs concerning the possibility configuration of the prejacent, "John is home." However, if she accepts that the prejacent is humanly possible given Alex's knowledge, i.e. she accepts John's asserted proposition at Level 1, she can derive the pragmatic presuppositions that were

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[92] The goal of this chapter is to show that human modality pragmatic presuppositions influence discourse. A complete model of how modals interact with other linguistic devices in discourse is beyond the scope of this dissertation, so we shall ignore the role of variable questions such as that of Mary in (54). Of course this is a key area of analysis for a precise characterization of the speech act effects of acts involving modals, so this will be an important area for future investigation.

[93] Since if Alex's assertion is rejected, Mary's question still has to be addressed, the discourse might be better represented by demoting her question in the Table stack. But again, the modest objective of this chapter is to show that modal pragmatic presuppositions systematically affect discourse, so these complications are put on the back burner.

introduced in 3.3.4-5 and evaluate it as an objective proposal for the common ground.

We will assume that she accepts John's asserted proposition and that it is added to Mary's commitment list and then to the common ground. This means that p is entailed by the common ground, and it is removed from the Table. Next, Mary must evaluate the pragmatic presuppositions, which, by virtue of being derivable from publically expressed beliefs of Alex, are taken to be discourse commitments of Alex. Note that the pragmatic presuppositions are not physically uttered, so they add only a denotation and no syntactic information to the Table.

Figure 10 K_2: Mary accepts p and derives Alex's pragmatic presuppositions

$\exists a,a',p'$: a is true & usually if $a'(x)$ then $p'(x)$ where a is an instantiation of a' and *John is home* is an instantiation of $p'(x)$ (= q in the Table)

$\exists b,b',p'$: b is true & usually if $b'(x)$ then $\neg p(x)$, where b is an instantiation of $b'(x)$ and *John is not at home* is an instantiation of $p'(x)$ (= r in the Table)

DC_{Mary}	Table		DC_{Alex}
	{ q }		q
	{ r, ¬r }		
Common Ground $s_3 = s_2 \cup p$		**Projected Set** $ps_3 = \{ s_3 \cup \{q\} \cup \{r\}, s_3 \cup \{q\} \cup \{\neg r\} \}$	

John has committed himself to q, but his assertion has only shown via scalar implicature that he at least believes that r is contextually possible. Since this means that he is pragmatically presupposing a common ground which includes both r and $\neg r$, which is already the case, it does not require a change to the common ground. This is similar to a polar question, where Speaker is not positively committed to either truth or falsity of the questioned proposition, but raises the issue in the hopes that another discourse participant will contribute information to settle it in the common ground. A modal assertion such as John's raises the issue of $\{ r, \neg r \}$ as part of the larger modal issue, but does not commit the Speaker to either way of settling it. We shall represent this in the same way that Fargas & Lucas represent polar questions. In the figure above, all projected common grounds include John's positive

commitment, but he projects separate common grounds for each value of *r* since he is not committed to either. From these, ideally, only one will be chosen, which would result in constraining the Possibility Configuration of the prejacent, thus contributing to settling the modal issue.

In this case, Mary believes that John would know a suitable instantiation of a' and accepts q. This entails that "John is at home" is a human possibility with respect to the common ground. The actual common ground is still indeterminate between 3 (if the first projected common ground is chosen) or 5 (if the second common ground is chosen) but Mary deems this sufficient for her purposes, i.e. sufficient reason to call John's house and check if he is there. Since Mary does not respond to the *r* issue, it is taken that the discourse demand has been satisfied (i.e. the answer to her question), and { *r*, ¬*r* } is removed from the Table without being settled. In sum, the new common ground entails q but is left as it was with respect to *r*.

In this example, we examined an example of a possibility assertion which was informative enough to give Hearer reason to take action. We saw that what occurred was an update to the Possibility Configuration of a proposition which was related to Hearer's question with respect to the context set. This consisted of upgrading the common ground such that "John is at home" was either in Configuration 3, where it is both a human necessity and a human possibility and its complement is a slight possibility, or in Configuration 5 where the proposition and its complement are both human possibilities but neither is a human necessity.

We might describe assertions in contexts such as that above as attempts to **refine** the possibility from <u>no more than contextual</u> to <u>(stereotypical) human</u>. This refinement is comparable to adding an adjective to a common noun. Suppose that everyone knows that John is a man. Speaker can restrict the set of men to which John belongs by asserting, "John is a smart man." This entails that John is among the set of smart men and not the set of dumb men. Speaker can similarly restrict the class of contextual possibilities to which a proposition belongs using human possibility assertions; if a proposition is a human possibility it is not a slight possibility.

With respect to this discourse only, the formalization is different but the results are similar to Willer's results. Willer supposes that Speaker and Hearer have a set of possibilities they take seriously, and a *might* assertion by Speaker is a proposal for Hearer to update the prejacent to one of her live possibilities. However, Willer does not

make this update dependent on any other information. Rather, he supposes that a proposition being a live possibility relative to one's internal information state is a result of that agent's evidence, but does not incorporate evidence into the context change potential semantics that he develops. He writes:

"The working assumption of my semantic proposal, then, is that inquiring agents distinguish between live possibilities and possibilities that are merely compatible with their evidence (which I will sometimes call "plain" or "mere" possibilities); *might*-statements are designed to change possibilities of the latter kind into live possibilities. This proposal does not require a detailed story about how agents draw this distinction in inquiry, and so I restrict myself to stating the obvious: there are various reasons an agent may have for taking a possibility seriously, including practical concerns, but it is safe to say that at least in many cases agents decide which possibilities to take seriously on the basis of plausibility. Some possibilities are far-fetched while others seem to be more reasonable, and in general only possibilities that meet a certain standard of plausibility play a significant role in one's practical and theoretical deliberation" (p. 6).

As can be seen, his idea for "live possibilities" as reflecting a threshold of plausibility is notionally very similar to stereotypical human possibilities, and his "mere possibilities" are notionally similar to contextual possibilities, both of which are compatible with Speaker's knowledge but not necessarily anything more. However, the mechanism for change Willer proposes is not directly dependent on the presence of evidence. That is, the presence of "positive evidence" is lacking from Willer's semantics. This may be sufficient to account for changes such as the one above, where Hearer simply accepts Speaker's assertion without questioning him. However, it fails to account for more complicated discourse events where the evidence for the prejacent directly affects the possibility status.

In the next section, we will see how once a modal assertion raises a modal issue, the exchange of positive evidence for the prejacent and the prejacent's complement can lead to a possibility configuration different from the initial configuration and different from that of either participant's initial belief state. Concretely, a common ground where p and $\neg p$ are no more than contextual possibilities ends up with both being human possibilities, when the

modals assertions actually made were *may p* and *must ¬p*. This will serve as corroboration, from the perspective of an overall discourse event, for positive evidence as an essential component of the meaning of modal assertions.

4.2.2 Settling on a Possibility Configuration indirectly

The example taken up in this section settles the modal issue by committing to Possibility Configuration 5, where both the prejacent and its complement are humanly possible, without ever asserting that the complement is humanly possible. This will serve as evidence for the social reality of modal issues and the influence of modal pragmatic presuppositions.

In the example below, we'll see what happens when two participants have conflicting beliefs. In this example, we use intensionally distinct but contextually complementary propositions. Suppose that Anne and Hanako are roommates to Belle. They have found that she is not at home and are discussing where she went. Imagine that they are presupposing that she went to only one place; within the discourse domain given, the truth of her having gone to one place entails the falsity of her having gone to any of the other places.

A person who thinks it is humanly necessary that Belle went to the store may have a reason such as, "usually, if our groceries are running low, then Belle goes to the store." If "Belle goes to the store" is *p* (the prejacent), this conditional could be generalized as *usually, if a then p*. From this same perspective, positive evidence for "Belle goes to the gym" would be positive evidence for *¬p*, such that it could be expressed as, *usually, if b then ¬p*. Consider the following dialogue.

(55)   Anne: Hm, I wonder where Belle went.

Hanako: She may have gone to the gym.

Anne: No, look. We're almost out of groceries. She must've gone to the store.

Hanako: Yeah, but it's Tuesday and she usually goes to the gym on Tuesdays.

Anne: Oh, yeah. Hm.

Anne and Hanako get in a debate about where Belle is. Hanako asserts that it would be a normal state of affairs for her to be at the gym. Anne asserts that the only normal state of affairs is her having gone to the store. Hanako accepts that it would be a normal state of affairs for her to have gone to the store, but maintains that her having gone to the gym would also be a normal state of affairs. Anne agrees, and they now have to consider two possible locations where Belle could be. Below, we shall view the inner workings of this exchange.

We will not be dealing with any examples where a modal assertion is rejected at Level 1 in this chapter, so we shall skip the step where Speaker accepts the Level 1 assertion and go straight to the objective proposal.

Figure 11 K_1: She may have gone to the gym.

Hanako asserts human possibility of "Belle went to the gym" and Anne accepts at Level 1

Belle may have gone to the gym[D]; {p}

$\exists a,a',p'$: a is true & usually if $a'(x)$ then $p'(x)$ where a is an instantiation of $a'(x)$ and *Belle went to the gym* is an instantiation of $p'(x)$ (= q in the Table)

$\exists b,b',p'$: b is true & usually if $b'(x)$ then $\neg p'(x)$, where b is an instantiation of b' and *Belle did not go to the gym* is an instantiation of $p'(x)$ (= r in the Table)

DC_{Anne}	Table		DC_{Hanako}
	{ q } { r, ¬r }		q
Common Ground $s_3 = s_2 \cup p$		**Projected Set** $ps_3 = \{ s_3 \cup \{q\} \cup \{r\},\quad s_3 \cup \{q\} \cup \{\neg r\} \}$	

K_1 in Figure 11 is identical to K_2 in Figure 10 from the last section up to the identity of *p*, *q* and *r*. Hanako has raised a modal issue and expressed commitment to *q*. However, as we shall see, in this case, Anne has contrary beliefs.

Figure 12   K₂: "No, look. We're almost out of groceries. She must've gone to the store."

Anne entails human necessity of "Belle did not go to the store," and gives evidence.

Belle must have gone to the store[D]; {o}

We are almost out of groceries[D]; {m}

$\exists a,a',p'$: *a* is true & usually if *a'(x)* then *p'(x)* where *a* is an instantiation of *a'(x)* and *Belle went to the gym* is an

instantiation of *p'(x)* (= q in the Table)

$\exists b,b',p'$: *b* is true & usually if *b'(x)* then *¬p'(x)*, where *b* is an instantiation of *b'* and *Belle did not go to the gym* is an

instantiation of *p'(x)* (= r in the Table)

$\exists c,c',p'$: *c* is true & always if *c'(x)* then *¬p'(x)* where *c* is an instantiation of *c'(x)* and *Belle did not go to the gym*

[went to the store] is an instantiation of *¬p'(x)* (= j)   <-- Note: strict entailment of *¬p*

DC_{Anne}	Table	DC_{Hanako}
¬q	{j, ¬j}	q
r	{r}	
m	{m}	
	{¬q }	
	{ q }	
	{ r, ¬r }	

Common Ground $s_4 = s_3 \cup o$	**Projected Set**
	$ps_4 =$
	$\{s_4 \cup \{q\} \cup \{\neg r\} \cup \{r\} \cup \{\neg q\} \cup \{m\} \cup \{j\},$
	$s_4 \cup \{q\} \cup \{r\} \cup \{r\} \cup \{\neg q\} \cup \{m\} \cup \{\neg j\},$
	$s_4 \cup \{q\} \cup \{r\} \cup \{r\} \cup \{\neg q\} \cup \{m\} \cup \{j\},$
	$s_4 \cup \{q\} \cup \{\neg r\} \cup \{r\} \cup \{\neg q\} \cup \{m\} \cup \{\neg j\}\}$

It seems that Anne has wrought chaos on the discourse context, but given that modal issues put issues on the table for the prejacent and its complement, she has not been entirely disruptive. First, by uttering "no," she is rejecting Hanako's discourse commitment. Every projected common ground is now empty. In order for any of them to be consistent, either Hanako has to retract her commitment to q or Anne has to retract hers to $\neg q$. Another alternative would be to agree to disagree, in which case the common ground would be unchanged with respect to q. This would mean that both Hanako's going to the gym and not going to the gym would be contextually possible and no more in the common ground, as before. However, there is another way to update the common ground which does not contradict Anne's assertion.

Anne can address the other issue on the table, { r, $\neg r$ }. This is what m [=*We're almost out of groceries*] does, it serves as an instance of b'. Because { r, $\neg r$ } is on the Table and it is common belief that Anne will try to increase the common ground in the optimal way but that she has already rejected Hanako's commitment, Hanako will be expecting Anne to address the other issue. This facilitates the interpretation of m as an instance of b', i.e. as evidence for the complement of the prejacent.

In evaluating m, Hanako can look for a way that m is stereotypically associated with not going to the gym, question whether or reject that such an association exists, or just accept that there is some stereotypical association. In this case, Anne provides the connection with her own modal assertion: there being no groceries is associated with going to the store, and if Belle is at the store she is not at the gym.

However, notice that Anne has already committed herself to the presuppositions necessary for the truth of human necessity even before her modal assertion. Anne has already rejected q and provided an instantiation of b' intended to entail r. As such, the necessity assertion adds no new commitments, but it does add a new issue and two additional *ps*.

Must $\neg p$ can express only human necessity of $\neg p$ or also contextual necessity of $\neg p$. For either to be true relative to the common ground, $\neg q$ and r must be entailed by the common ground. However, the contextual necessity has a stricter requirement: j must be the case. That is, given the manner maxim such that *must* $\neg p$ is not used if $\neg p$ is known directly (discussed in 2.1.3), Speaker can felicitously assert *must* $\neg p$ if he believes he knows that an

instantiation of the antecedent of a strictly implicative linking proposition, such as *j*, is true. Since Anne has not indicated whether she intends contextual or human necessity, and at minimum she must believe ¬*q* and *r*, these two will be interpreted as her discourse commitments, while { *j*, ¬*j* } will be raised as an issue until confirmed or eliminated. In many cases, Hearer will assume that Speaker does not know a proposition suitable to be the antecedent of *j* and disregard the ambiguity for human necessity, but it can come up. (For example, (15) from Chapter 2, where Speaker was prompted to clarify whether he was proposing human necessity or contextual necessity)

Continuing with the conversation, if Hanako accepts *m*, she forfeits her option to dispute that "Belle did not go to the gym" is a human possibility. This is what she does in producing K₃ below.

Figure 13   K₃: Yeah, but it's Tuesday and she usually goes to the gym on Tuesdays.

Hanako accepts Anne's evidence, but offers evidence backing her own commitment.

It's Tuesday and she usually goes to the gym on Tuesdays[D]; {u}

We are almost out of groceries[D]; {m}

∃*a,a',p'*: *a* is true & usually if *a'(x)* then *p'(x)* where *a* is an instantiation of *a'(x)* and *Belle went to the gym* is an instantiation of *p'(x)* (= q in the Table)

∃*b,b',p'*: *b* is true & usually if *b'(x)* then ¬*p'(x)*, where *b* is an instantiation of *b'* and *Belle did not go to the gym [went to the store]* is an instantiation of *p'(x)* (= r in the Table)

∃*c,c',p*: *c* is true & always if *c'(x)* then ¬*p'(x)* where *c* is an instantiation of *c'* and *Belle did not go to the gym [went to the store]* is an instantiation of ¬*p* (= j)   <-- Note: strict entailment of ¬*p*

DC_{Anne}	Table	DC_{Hanako}
¬q	{u}	q
	{j, ¬j}	u
	{¬q }	
	{ q }	

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Common Ground $s_5 = \{s_4 \cup \{m\} \cup \{r\}\}$	Projected Set
	$ps_5 = \{s_5 \cup \{q\} \cup \{\neg q\} \cup \{\neg j\}, s_5 \cup \{q\} \cup \{\neg q\} \cup \{j\}\}$

Hanako accepts m, making it, and r which is entailed by m (given that m is accepted as an instantiation of b), mutual commitments and thus common ground. The current common ground allows for Configuration 2, 4 or 5. Configuration 5 was one of the Possibility Configurations projected by Hanako's assertion, so there is still a possibility she can accept without changing her commitments. In other words, Anne's disagreement has updated the common ground without requiring Hanako to retract her discourse commitment. This is possible because due to the interaction of pragmatic presuppositions which result in multiple issues being put on the Table. A modal assertion is not necessarily all or nothing.

Hanako's acceptance of m has eliminated the projected set which includes $\neg r$ and thus clears $\{r\}$ and $\{ r, \neg r \}$ from the Table. However, we still have contradictory discourse commitments making the remaining projected sets empty. Since the discourse context is not stable, unless they agree to disagree and stop here, the conversation continues.

Hanako, in order to get Anne to retract her commitment to $\neg q$, has offered u [= *It's Tuesday and she always goes to the gym on Tuesdays*] as evidence for q. The interpretation for u is similar to that of m. There are three issues on the Table and of those, Hanako is committed to q. Assuming that u is relevant to the discourse event and that Hanako's immediate goal is getting her commitment accepted, Anne will be prompted to interpret u as an instantiation of q. Given that Anne does so, if she accepts u, she will have to retract her commitment to $\neg q$. This would also entail $\neg j$. This is what Anne does.

Figure 14   K$_4$: Oh, yeah. Hm.

Anne accepts Hanako's evidence. The modal issue is resolved

It's Tuesday and she usually goes to the gym on Tuesdays[D]; {u}

We are almost out of groceries[D]; {m}

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$\exists a,a',p'$: a is true & usually if $a'(x)$ then $p'(x)$ where a is an instantiation of $a'(x)$ and *Belle went to the gym* is an instantiation of $p'(x)$ (= q in the Table)

$\exists b,b',p'$: b is true & usually if $b'(x)$ then $\neg p'(x)$, where b is an instantiation of b' and *Belle did not go to the gym [went to the store]* is an instantiation of $p'(x)$ (= r in the Table)

$\exists c,c',p'$: c is true & always if $c'(x)$ then $\neg p'(x)$ where c is an instantiation of c' and *Belle did not go to the gym [went to the store]* is an instantiation of $\neg p'(x)$ (= j)   <-- Note: strict entailment of $\neg p$

DC_{Anne}	Table		DC_{Hanako}
Common Ground $s_{6=} s_5 \cup \{u\} \cup \{q\} \cup \{\neg j\}$	**Projected Set** $ps_6 = s_6$		

Since Anne accepts u, which entails q, she commits herself to q and has to reverse her commitment to $\neg q$. This makes both u and q common commitments, moving them to the common ground and removing them from the individual discourse commitment lists and the Table. It also entails $\neg j$, settling the issue of $\{j, \neg j\}$. All the items of the modal issue have been settled, and the Possibility Configuration has been determined to be 5, where both the prejacent and its complement are humanly possible. A discourse which involved physical utterances of only *may p* and *must ¬p* ended up entailing *may p* and *may ¬p*. This is evidence of the social reality of modal issues and the activity of modal pragmatic presuppositions in settling them.

To sum up what we have observed in this interaction, we have seen that when a modal utterance is made, the relation of both the prejacent and its complement to the common ground are raised as issues. In the case of a possibility assertion, Speaker is committed to positive evidence for the prejacent, but uncommitted to evidence for the prejacent's complement. This resulted in two projected common grounds: one where there was evidence for the prejacent's complement and one where there was not. Both of them entailed evidence for the prejacent, reflecting Speaker's commitment to positive evidence for the prejacent, and its human possibility, within the larger modal issue.

Settling the modal issue requires agreement on both items. However, Anne disagreed with Mary and in thus doing committed herself to there being no positive evidence for the prejacent. She also committed herself to there being positive evidence for prejacent's complement by giving an instantiation of it. This resulted in her committing herself to both of the propositions which are necessary to entail human necessity of the complement of the prejacent. She then uttered a necessity assertion reaffirming this and raising the issue of whether the prejacent should be a contextual necessity in the common ground or not. Mary accepted her positive evidence for the prejacent's complement, but rejected that there was no positive evidence for the prejacent and gave an instantiation of such evidence. Hanako accepted, and the prejacent becomes settled as Possibility Configuration 5.

What does that mean? Exactly what the dialogue suggests. If Hanako and Anne truly wished to find Belle, this would likely lead them to search both the store and the gym, or search for someone who might actually know where she is. What we have done in this exercise is determine the dynamics behind the discourse, and characterized the stances of the participants. We have shown that discourse commitments, which we are taking to be how pragmatic presuppositions are interpreted at the discourse level, are what prompts Hearer to disagree with a modal assertion by Speaker. This also shows exactly what propositional content she is disagreeing with: positive evidence for the prejacent. We have also shown that, because a modal assertion also raises the issue of the prejacent's complement, disagreement in a modal issue can update the common ground without any participant having to retract their discourse commitments.

Incorporating pragmatic presuppositions of the existence of positive evidence for the prejacent, and interpreting them as discourse commitments at the discourse level, allows a fine-grained accounting of what happens in discourse events involving modals, and the concept of Possibility Configurations allows a description of the end results which reflects the changes to the relation of the prejacent with respect to the context set.

Chapter summary

In this chapter I proposed that modal assertions raise modal issues. This approach allows us to capture the notional similarities of epistemic possibility assertions with both non-modal assertions and polar questions. While

a modal assertion commits the Speaker to positive evidence for the prejacent similar how a non-modal assertion commits him to the truth of the uttered proposition, it also raises the issue of positive evidence for the prejacent's complement without committing Speaker to either way of settling the issue.

We saw that epistemic necessity assertions also raise an issue of whether the prejacent should be contextually necessary or not, but only commit Speaker to human necessity. This could be accounted for by differentiating between the type of positive evidence needed for each.

In this way, at the level of discourse, modal assertions are a hybrid of questions and assertions. They are a way of settling an issue or answering a question under discussion when the correct answer is not available to the current discourse participants. By raising the issue, a participant can share his related information even if it is not determinate, as in 4.2.1, or both participants can cross-examine their relevant beliefs and arrive at a more precise answer or conclusion than just "either true or false," as in 4.3.2. The use of modal sentences to raise and settle modal issues is a true example of the resourcefulness of humans in using language.

Conclusion

Over the course of this dissertation I have advocated for a tripartite approach to analyzing utterance meaning in discourse, that is, an approach which does not split analysis into independent "pragmatic" and "semantic" types, but takes the common ground, the Cooperative Principle and semantics as independent but highly integrated systems which produce a larger process called discourse.

This is not to say that they should not be investigated as coherent, independent systems. However, an essential part of understanding what the contribution of the independent system is to recognize what is NOT a contribution of that system. Kratzer's human modality semantics makes no requirements for what kind of knowledge must be in an epistemic modal base or a stereotypical ordering source or even how these two formal objects should interact logically, nor should it; that is a job for the Cooperative Principle, which links semantics with the common ground.

Simply allowing the quantity maxim to operate on the semantics in connection with common ground generates an essential mechanism for interpretation which I have called "a linking proposition." Hearer expects Speaker, as per the Cooperative Principle, to be able to activate this proposition, and Speaker knows Hearer expects this. These expectations manifest as pragmatic presuppositions to which Speaker is committed in the common ground and which are not part of the semantic meaning but originate from the semantic meaning.

Identifying these pragmatic presuppositions does away with the need to suppose modal bases relative to the knowledge of individuals other than Speaker or to that of larger groups; it accounts for the intuitive differences in "objective" and "subjective" modal assertions; it offers insight into embeddability facts, it accounts for what Hearer is arguing with, it allows for proffering speech act effects, and it shows that modal assertions can lead to additions to the common ground which no given discourse participant proposed.

This is achieved without adding any new theoretical devices. It does, however, require that we accept doubly-relative modality as the standard for epistemic modals. However, since doubly-relative modality is already employed for deontic modality, this argument maintains an Occam's razor appeal.

As I hinted at the beginning of the first chapter, the concept of the linking proposition may allow similar explanations for the different kinds of directive force speech effects of deontic assertions (requesting, ordering, suggesting). Of course, a better understanding of speech act effects will require a better understanding of the syntactic distribution of modal verbs, the modal base and the ordering source. When and why does the modal base take the event time of a verb instead of that of the speech act? Are there structural factors in determining the conversational background chosen for the ordering source? However, as I hope I have shown, future comparative investigations of epistemic and deontic modality will surely benefit from a combination of the structural clues that have been classically relied on such as scope and distribution facts with the clues we can get from their behavior in discourse, which have been the principle topic of this dissertation.

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