Chapter 1

Inquisitive Semantics

This chapter introduces inquisitive semantics as a research program for the study of the semantics of natural language questions and disjunctions. I will begin by providing a brief outline of the necessary background on question semantics and erotetic logics, and I will then present inquisitive semantics, by first laying out its main tenets and then defining a propositional logical system, InqL, that instantiates the inquisitive program.

1.1 Preliminaries

Since Hamblin's (1958) seminal paper on the semantics of questions, most semanticists and philosophers have come to agree that "knowing what counts as an answer is equivalent to knowing the question," (Hamblin, 1958) that is, the semantic content of a question must give its answerhood conditions. One standard way to implement this idea is to identify the meaning of a question with a set of propositions, namely the set of all propositions that are possible answers to that question (the earliest example of such a semantics can be found in Hamblin, 1973). Probably the most successful implementation of this intuition is due to Groenendijk and Stokhof (1984), who take the *sense* of a matrix question to be the set of all its possible mutually exclusive answers, partitioning the logical space. The partition approach will serve as a point of departure in what follows.[1]

1.1.1 A partition theory of questions

Within the partition framework, it is customary to define a query logic over a standard assertive language,[2] by means of a question-forming operator that applies only at the topmost level, never occurring in embedded subformulas. Thus:

[1]The formulation of the partition theory that I will present is mostly based on Groenendijk (1999), or rather a straightforward adaptation of that system to a *propositional* query language.

[2]By abuse of terminology, I will for the most part of this thesis use the term 'language' to refer to a set of well-formed formulas. Whenever I use it to mean a set of symbols from which formulas are constructed I will explicitly say so.

Definition 1 (Classical propositional query language). Let L be a language of propositional logic. QL, a classical propositional query language, is the smallest set such that, for each $\varphi \in L$, $\varphi \in QL$ and $?\varphi \in QL$. $\dashv$

The language QL contains such formulas[3] as p, $?p$, $?(p \wedge q)$, $?(p \to q \vee (r \wedge s))$, but not $p \wedge ?q$, $p \to ?q$, $\neg\neg\neg ?p \to ??r$, for obvious reasons. The interrogative formulas $?\varphi$ that indeed are a part of this language are to be interpreted as polar questions that partition the logical space, in a manner I'll make explicit shortly, so as to contain only the two logical cells that correspond to the assertive formulas (answers) φ and $\neg\varphi$, or "yes" and "no."

Models for a classical propositional query language are an extension of possible worlds models for declarative semantics. Specifically, we will deal with models that consist of a relation between possible worlds, intended to model a notion of *indifference*, following Hulstijn (1997). Intuitively, two worlds will be connected just in case the difference between those two worlds is not at issue. For example, suppose we want to consider a model for the question

(1) Is it raining?

In our terms, a model for (1) cannot have a connection between worlds w_1 and w_2 when they disagree as to whether (2), the assertive sentence underlying (1), is true or not.

(2) It is raining.

That is, a model for (1) tells us that we are interested in what distinguishes worlds where (2) is true from those where it is false. We are however indifferent to all other issues, so connections will be present between, say, two worlds that agree as to whether (2) but disagree with respect to (3), which is not at issue.

(3) France is a monarchy.

Now, if we take this relation of indifference to be an equivalence relation, it follows from the partition theorem that it uniquely induces a partitioning of the underlying set of possible worlds it is built upon. Thus, the minimal model for (1) is the relation of indifference on an underlying set of possible worlds that contains all pairs of worlds except those where the two worlds disagree as to the value of (2). Furthermore, it induces a unique partition of the underlying set of worlds, namely, that partition which has two cells, one occupied by all worlds where (2) is true, and the other made out of all the worlds where (2) is false.

Definition 2 (Classical query models). A model for the classical query language QL is a reflexive, symmetric and transitive relation $\sigma \subseteq W \times W$, where W is the set of all total valuations on the set P of propositional atoms of QL. $\dashv$

The models of Definition 2 can be represented pictorially as in Figure 1.1, a model for the query language with only two propositional atoms, say p and q. Each circle represents a world in the basic set of possible worlds W on which

[3]Throughout this text, I will assume standard notational conventions, viz. left associativity and the scale of association of logical connectives whereby '$\neg$' associates to the smallest subformula to its right, and '$\wedge$' and '$\vee$' take precedence over $\to$. That is, $\neg\varphi \vee \psi$ is an abbreviation of $((\neg\varphi) \vee \psi)$, and $\varphi \wedge \psi \to \theta \vee \chi$ an abbreviation of $((\varphi \wedge \psi) \to (\theta \vee \chi))$. The question unary connective '?' default-associates in the same manner as negation.

the model proper is a relation; the left hand digit gives the truth value of p at that world and the right hand one that of q. The relation is represented by arrows connecting worlds. Notice that the model is, strictly speaking, only the relation, the arrows in this representation, that is, our model is the reflexive, symmetric and transitive closure of

$$\big\{\langle w_{11}, w_{10}\rangle, \langle w_{11}, w_{01}\rangle, \langle w_{11}, w_{00}\rangle, \langle w_{10}, w_{01}\rangle, \langle w_{10}, w_{00}\rangle, \langle w_{01}, w_{00}\rangle\big\} \ .$$

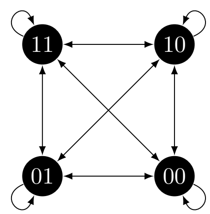

Figure 1.1: The indifferent, ignorant model for $P = \{p, q\}$

In this example, all reflexive pairs in $W \times W$ are present, indicating that all possibilities are open. I will call such a model an *ignorant* model. Moreover, every two distinct worlds are connected to one another, which I interpret to mean, as sketched above, that nothing is at issue in this model, that is, that the model is *indifferent*. Whenever a model is a total relation over the underlying set of worlds W, as in Figure 1.1, it is both ignorant and indifferent. Formally:

Definition 3 (Ignorance and indifference). For $\sigma \subseteq W \times W$ a model of a query language according to Definition 2, we say that σ is *ignorant* iff

$$(\forall w \in W)\ \langle w, w\rangle \in \sigma \ ,$$

and that σ is *indifferent* iff

$$(\forall \langle w, w\rangle, \langle w', w'\rangle \in \sigma)\ \langle w, w'\rangle \in \sigma \ . \qquad \dashv$$

Remark 4. A model $\sigma \subseteq W \times W$ is ignorant and indifferent iff $\sigma = W \times W$.$\dashv$

We are now ready to give a semantics for the language QL. As the definition of an ignorant state above may have already hinted at, I find an update semantics (Veltman, 1990, 1996) that mirrors information growth by eliminating worlds from models to be especially perspicuous. Luckily, the basic intuitions that a Stalnakerian view of the common ground (or of an information state) gives us can be straightforwardly imported into the enriched model theory used here. Nothing in this thesis hinges on the choice of an update semantics formulation, in a sense to be made explicit in Chapter 2, although the remainder of the present chapter will exclusively refer to update semantics.

Definition 5 (Semantics for QL). For σ a classical query model as in Definition 2, the update of σ with a formula φ of QL, written $\sigma[\varphi]$, is inductively

defined as follows.

$$\begin{aligned}
\sigma[p] &= \{\langle i, j\rangle \in \sigma : i(p) = j(p) = 1\}\\
\sigma[\neg\varphi] &= \sigma - \sigma[\varphi]\\
\sigma[\varphi \wedge \psi] &= \sigma[\varphi] \cap \sigma[\psi]\\
\sigma[?\varphi] &= \{\langle i, j\rangle \in \sigma : \langle i, i\rangle \in \sigma[\varphi] \text{ iff } \langle j, j\rangle \in \sigma[\varphi]\} \qquad \dashv
\end{aligned}$$

In words, the atomic clause above eliminates all pairs of worlds such that one or both worlds assign the value 0 (false) to p, and the question clause keeps only those pairs of worlds whose two elements[4] are in sync with respect to passing or failing an update with φ. The conjunction and negation clauses are self explanatory, and disjunction and implication can be defined by standard abbreviations: $\varphi \vee \psi$ as $\neg(\neg\varphi \wedge \neg\psi)$ and $\varphi \to \psi$ as $\neg(\varphi \wedge \neg\psi)$.

This semantics can express the full gamut of classical, partition questions à la (propositional) Groenendijk and Stokhof (1984). To give just one example, Figure 1.2 represents the update of a simple σ as in Figure 1.1 with the formula $?p$. As mentioned earlier, because the indifference relation that our models represent is an equivalence relation, the partition theorem allows to go back and forth between the relation and the partition it induces. In Figure 1.2, I highlight the partition induced by the indifference relation by drawing a shape around each cell.

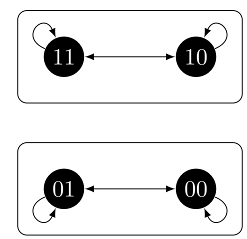

Figure 1.2: $\sigma[?p]$

1.1.2 Issues with the partition framework

The kind of partition theory instantiated above for the propositional case has been quite influential for the past twenty-five years;[5] indeed, virtually all accounts of question semantics have assumed its basic tenets to be incontrovertible desiderata. In the paragraphs that follow, I will question the framework from three different fronts.

[4] Notice that, to see whether a world w makes a declarative sentence true or false we can simply look at whether the corresponding reflexive pair is in the update with that formula.

[5] But it is important to remark that the propositional case I am restricting this discussion to was never the focus of much attention due to its supposed triviality (Groenendijk and Stokhof, 1997, but see). This thesis will show however that a number of interesting questions arise even from considering only propositional logic.

Formal issues

All instantiations of the partition theory that I am familiar with, in fact most accounts of the logic of questions for that matter, entail a sharp syntactic and semantic distinction between declaratives and interrogatives. Consider for example the language QL of Definition 1. The definition of that language proceeded in two stages, first we defined (or rather assumed) a language of propositional logic, and then we added to that set the result of prefixing each of the standard propositional formulas with a '?'. It is therefore possible to distinguish between two subsets of QL, call them L and Q, respectively the declarative sentences of the language and the interrogative ones. This syntactic distinction is meaningful at the semantic level as well. The sentences in L have the potential to eliminate reflexive pairs of worlds in a model, while those of Q will eliminate non-reflexive pairs, i.e., connections between possible worlds. Crucially, no combination of these two kinds of semantic processes, providing information and raising issues, is possible with the language we are considering, as any given sentence of QL is either declarative or interrogative. This seems unwarranted:

(4) Jane is a genius, but does she know it?
$p \wedge ?q$

In (4), we have a natural language sentence that conjoins a declarative sentence and an interrogative one, to form a complex sentence that would most intuitively be formalized by a formula of the shape $p \wedge ?q$. Formulas such as this are entirely absent from QL.

Moreover, QL does not even allow, say, conjunction of interrogative sentences as in (5).

(5) Is John coming to the party, and is Mary coming as well?
$?p \wedge ?q$

By stipulating that the question operator can only apply at the topmost level in a formula, the language QL does not recognize such formulas as in (4) and (5) as well-formed. Now, one might argue that the kind of conjunction we see in (4) and (5) is of an importantly different kind than that of say (6), where two declaratives are conjoined.

(6) John fell and Max pushed him.

The fact that there is no real need for a pause between conjuncts in (6), as opposed to (4) or (5), might be taken to be an indication that 'and' in (4) and (5) operates at a higher level than 'and' in (6), perhaps the discourse level. Be that as it may, a query language in the most abstract sense ought to be able to represent, respectively express, *hybrid* formulas, respectively meanings, that both provide information and raise issues. The question of how natural language expresses such meanings is a separate one, and it should inform us about how the query language *applies* to the study of natural language, what restrictions are in order, what level of meaning (term-level, sentence-level, discourse-level) is involved in the expression of individual meanings. It is therefore my position that the logical building blocks of a semantics of questions should allow the well-formedness of sentences whose meanings are interpretable, even when it may seem that such sentences do not have a direct correlate in a sentence of a natural language.

Now, we could modify the syntax and semantics of QL in order to include sentences of the same form as (4) or (5) as well-formed and interpretable, in fact this is rather straightforward if we redefine conjunction as update sequencing or add a sequencing clause to the update definitions. The resulting language is certainly an improvement for the reasons I present above, but it is not enough. Consider the following example of a possible question in an (extremely) introductory set-theory exam.

(7) Answer one of the following two questions.
a. Is the collection of all infinite sets a set?
b. Is the Axiom of Choice equivalent to the Well-Ordering Theorem in ZF?

Intuitively, (7) offers two questions to the examinee, namely (7-a) and (7-b), and asks of the examinee that she choose one of these two questions and answer it. Crucially, the examiner will be satisfied with an answer to either question.

One intuitively compelling (propositional logic) formalization of the inquisitive discourse in (7) is the formula $?p \vee ?q$, which in fact has been used at least since Groenendijk and Stokhof (1984). Even if we change the syntax of QL so as to let this formula be well-formed, making it interpretable within the partition theory involves a sophisticated mechanism of lifting $?p$ and $?q$ to generalized quantifiers over questions and connecting the resulting generalized quantifiers via disjunction (see Groenendijk and Stokhof, 1984, 1989). While Groenendijk and Stokhof argue that these lifted meanings account for both matrix and complement disjunctions of questions, Szabolcsi (1997) makes a strong empirical and conceptual case against using the lifted objects in matrix contexts. I will return to this issue closer to the end of this chapter; for now, it suffices to note that QL's heavily constrained syntax and semantics make it either impossible or non-trivially cumbersome to express the category of formulas that may be intuitive representations of discourses like the one in (7).

Another interesting consequence of this sharp formal distinction between declarative and interrogative sentences is that such query languages have a less than obvious proof-theory. To give just one example, if we take a standard update semantics definition of semantic entailment and assume the existence of a sound and complete proof system for it, it evidently lacks a deduction theorem.

Definition 6 (Support). A model σ *supports* a formula φ of QL, notated $\sigma \vDash \varphi$, iff $\sigma[\varphi] = \sigma$. $\dashv$

Definition 7 (Entailment). For two formulas φ and ψ of QL, we say that φ entails ψ, in symbols $\varphi \vDash \psi$ iff for all models σ, $\sigma[\varphi] \vDash \psi$. $\dashv$

Under the definitions above, and assuming the existence of a sound and complete turnstile relation, it is easy to see that $p \vdash ?p$, or more generally, a question is entailed by any of its answers. However, we do not have that $\vdash p \rightarrow ?p$, as one would expect from a standard logic with a deduction theorem, for the very simple reason that $p \rightarrow ?p$ is *not* a formula of QL. Lack of a deduction theorem is what made the axiomatization of Groenendijk's (1999) logic by ten Cate and Shan (2007) a more sophisticated endeavor than the typical axiomatization of tautologies: ten Cate and Shan (2007) give a sound and complete axiomatization *of the entailment relation* of Groenendijk's Logic of Interrogation (1999).

Notice that the proof-theory of erotetic logics is not a matter only of interest to the pure logician. Since at least Belnap and Steel (1976), having a formal theory of the relation between questions and answers and between questions and their subquestions has been an important desideratum of the erotetic logic enterprise. One compelling way to achieve that goal is to make sure entailment (i.e., $\vDash$) encodes the relations of answerhood and subquestionhood, besides (assertive) consequence, as done for example by Groenendijk (1999).

Ineffable meanings

Moving on to the adequacy of the partition theory to describe interrogative meanings, it is important to note that Groenendijk and Stokhof's original work had already encountered meanings that seemed to go beyond partitions. From the realm of constituent questions, the case of mention-some questions is an especially well-known one. Questions such as (8) are most typically taken not to require a complete answer (in Groenendijk and Stokhof's sense of 'complete'), and answers to it are also typically interpreted in a non-exhaustive way, suggesting that the meaning of (8) is a set of non mutually exclusive answers.

(8) Where can I buy Austrian newspapers?
At the Neue Galerie in the Upper East Side.

At the level of a propositional query language, an even more telling example can be found in the elusive case of conditional questions, as in (9).

(9) If John comes to the party, will Mary come as well?

Under at least one reading (indeed, I would submit, the most salient reading)[6] of (9), it is a polar question where the 'yes' answer states (10-a) and the 'no' answer (10-b).

(10) a. If John comes to the party Mary will also come.
$p \rightarrow q$
b. If John comes to the party Mary won't come.
$p \rightarrow \neg q$

There are a number of competing analyses of (9) on the market, the one I will adopt here was proposed by Velissaratou (2000) and used by Groenendijk (2007, 2008a). In a nutshell, Groenendijk argues that a conditional question such as (9) is most naturally translated into a formula like $p \rightarrow ?q$, and it corresponds to a meaning that distinguishes two possible answers, namely $p \rightarrow q$ and $p \rightarrow \neg q$, that are *not* mutually exclusive. Indeed, the two propositions these formulas correspond to *overlap*, in that they both contain the $\neg p$ worlds. Figure 1.3

[6] The other possible reading inquires about the existence of a certain connection, perhaps most naturally a causal one, between the antecedent and the consequent. In that reading, the 'yes' answer means the same as in the reading we are interested in, namely that $p \rightarrow q$, but the 'no' answer does not commit the responder to $p \rightarrow \neg q$, it is rather just the statement that there is no necessary, causal connection between p and q. A natural paraphrase of this 'no' answer is something like "No, it may well be that John comes to the party but Mary doesn't, the two situations are just completely independent of each other." See also footnote 19.

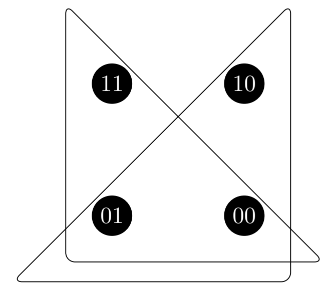

Figure 1.3: If p, q?

highlights the two possible answers to the question "if p, q?" in this approach.[7]

This proposal has the advantage of assigning the expected answerhood conditions to conditional questions without assuming more sophisticated mechanisms than those available in a standard propositional logic, but it implies a view of question meanings that accepts non-partitioning questions, therefore going beyond the expressive power of QL.

There are two main alternative proposals that try to maintain the partition picture. Hulstijn (1997) argues that the conditional question $p \rightarrow ?q$ has three possible answers, namely $p \wedge q$, $p \wedge \neg q$ and $\neg p$, an answer-set which partitions the logical space. He further analyzes answers of the sort $p \rightarrow q$ as partial answers to the conditional question. While his proposal succeeds in preserving the partition picture, it does so at a cost. Firstly, in keeping with the partition theory's notions of answerhood, Hulstijn must say that the answers in (10) are only partial answers, i.e., that they somehow only partially resolve the issue raised by (9), which seems counterintuitive: after an utterance of (9), any of the answers in (10) seem to address the issue raised fully, not just partially. Secondly, it is a consequence of this proposal that the answers $p \wedge q$ and $p \wedge \neg q$ are complete answers to the question posed, which is not the case: a sentence like "John and Mary are coming to the party" certainly addresses the issue raised by (9), but it provides extra information, namely that John is coming to the party, which was not the subject of inquiry. This again goes against the notion of a complete answer in the partition theory, as the answer set is supposed to contain those answers that fully resolve the issue raised *and only* the issue raised. Thirdly, the answer $\neg p$ is predicted to be appropriate, also an undesirable result on empirical grounds. If someone were to respond to (9) with "John isn't coming to the party," he might be doing a number of things, such as signaling that the question is irrelevant or protesting against a possible presupposition of the question, but he would not be answering the question in any intuitive sense. Clearly, it is important to distinguish the status of $\neg p$ from that of answers to the question, complete or partial, and Hulstijn's proposal can

[7] The reader will have no doubt noticed that I'm using $\rightarrow$ to represent natural language *if... then*. While we know that this is an oversimplification, I will ask for some suspension of disbelief on the grounds that 1. material implication can capture *some* of the properties of English *if... then* and, more importantly, 2. part of the objective of this thesis is to explore *propositional* erotetic systems; as such, the tools of modal logic or of truly dynamic update semantics, necessary to give a more adequate semantics of natural language conditionals, are not at my disposal.

only do so via some superimposed pragmatic mechanism that excludes $\neg p$ as an answer to (9).

Isaacs and Rawlins (2008) explore a different line, proposing that conditional questions be analyzed in a properly dynamic, stack-based update system. Informally, they define an update with *if* φ, ψ that does the following. First, a copy of the state being updated is created and put on top of it, forming (or adding to) a stack. Then, that state is updated with the antecedent, and finally the resulting state is updated with the consequent, in the case of conditional questions, a question. This proposal is still within the partition framework: the update with $?q$ is performed on the topmost state in the stack which has already been updated with the antecedent p, so the inconvenient $\neg p$-worlds are not in that state, which is therefore partitioned by $?q$. An affirmative answer to the question percolates down to the original state, discharging the temporary p-state, and resulting in an update of the original state with $p \rightarrow q$, as intended. Similarly for the negative answer.

This proposal is superior to Hulstijn's in that it delivers the desired answerhood conditions, but it achieves that goal by resorting to the expressive power of a full dynamic system. Dynamic systems are of course nothing to be afraid of per se, but they add significant complexity to an analysis, a move that must be adequately motivated. Groenendijk's and my contention is that, in this particular case, a dynamic system is not required, given that the desired answerhood conditions become expressible in a perfectly static system if we just drop the partition requirement, one I argue should be dropped for independent reasons as well, as the present thesis hopes to show.

As demonstrated by Figure 1.3, conditional questions can be given a very simple, static semantics if we are allowed to express meanings that *do not* correspond to partitions. Such meanings are inexpressible in the query system QL or any of its partition theory cousins, pace Isaacs and Rawlings's (2008) dynamic system.[8]

In later sections of this thesis I will discuss other classes of meanings that cannot be expressed by partitions, namely alternative questions and a certain use of (declarative) natural language 'or'.

[8] As discussed in footnote 7, the simple propositional logics I am considering lack the tools to express strict implications and other more sophisticated notions. It is however interesting to note that perhaps a theory of conditionals such as the one introduced by Stalnaker (1968) can also preserve the partition framework while yielding the right answerhood conditions, as Daniel Rothschild pointed out to me. Speaking informally, $[\![if\ p,\ q]\!]$ can be seen as an update function that keeps in a state all those worlds w such that the closest p-world to w is a q-world, assuming some appropriate extension of the update partition system QL that can encode an accessibility relation, and under a presupposed similarity ordering. Similarly for $[\![if\ p,\ \neg q]\!]$. Now, these two sets correspond to the Stalnaker conditionals of the answers in (10) but, contrary to what happens if we consider material implication in a static system, the two sets of worlds are disjoint. Suppose there is some w that is in both, then w must be a world such that its closest p-world is both a q-world and a $\neg q$-world, which is a contradiction. Therefore, the Stalnaker conditionals that correspond to the answers in (10) are disjoint and form a partition of logical space.

Let me reiterate my position on this matter. While granting that many if not most uses of natural language conditional constructions express meanings that material implication fails to capture and that might necessitate a modal analysis, I am for the purposes of this thesis interested in exploring the simplest propositional logic and discovering just how far we can take it, trying to express question meanings. I therefore leave both a careful development of a modal analysis of conditional questions and a discussion of its merits and shortcomings to future work.

Why partitions?

The strongest empirical argument for the partition theory comes from the realm of constituent *wh*-complements. Groenendijk and Stokhof (1982, 1984) argue that, in light of the inconsistency of statements like (11), an embedded question must denote its true and exhaustive answer, which has as a consequence that matrix questions correspond to partitions.

(11) #John knows who came to the party, but he's not sure if Jane did.

Even if we grant that this is in fact always the case with embedded constituent questions, it is less clearly so with matrix questions. Surely, (13-a), with a focus intonation, must be interpreted as an exhaustive answer to (12), but I find it at least arguable whether (13-b), with no special intonation, or the non-fragment answers in (13-c) and (13-d), are necessarily, or even most naturally, interpreted exhaustively.

(12) Who came to the party?

(13) a. [Mary $]_F$.
b. Mary.
c. Mary came to the party.
d. Mary did.

The partition theorist's only possible reply to this observation is that the answers in (13-b)–(13-d) are partial answers, the same applying to the non-exhaustive question-answer pair in (8). Now, if the notion of a partial answer is taken to be purely technical and defined simply as a non-exhaustive answer, then the partition theory's contention becomes irrefutable: exhaustive answers will be the ones our semantics produces, and partial answers will be acceptable in some cases. If however we believe that partial-answerhood should capture an *intuitive* notion, then the partition theorist's reaction to the cases above becomes much less convincing, for the simple reason that, both in (8) and (13), the answers are perfectly felicitous, addressing the question asked, and, at least in (8), resolve it completely. Calling these "partial answers" seems like a dubious move.

If these observations are correct, they suggest that, while a partition theory may be the right way to analyze constituent complement questions, exhaustivity seems too strong a requirement for matrix questions.

Moreover, recall that the partition theory required us (in fact Groenendijk, 1999) to stipulate that the indifference relation captured by the query models be an equivalence relation. This meant stipulating that indifference is reflexive, symmetric and transitive. Now, from a purely conceptual point of view, it is easy to see why a relation of indifference ought to be reflexive and symmetric. We cannot possibly be interested in the difference between a world and itself — there is none — and, if we are not interested in the difference between w and v, then we cannot be interested in the difference between v and w either. The requirement of transitivity, however, is much less intuitive.

Indeed, it seems necessary, at least conceptually, to grant that it is possible for us to be indifferent with respect to how w differs from v and how v differs from u, but *not* to be indifferent regarding how w differs from u. The difference between w and u may well be big enough for us to be interested in it.

Interestingly, the partition theory of questions more or less tacitly underlies Lewis's work on *relatedness* and *subject matter*. In particular, Lewis (1988) asks us to think of subject matter (e.g., the subject matter of a conversation, or even just of an assertion in the shape of single sentence), *equivalently* as one of the following:

(14) a. A part of the world in intension,
b. an equivalence relation between possible worlds,
c. a partition, and
d. a question.

Lewis is the first to admit that (14-a) is an elusive notion, so let us disregard it without much compunction. Although Lewis does not give an intuitive gloss of the equivalence relation (14-b), a natural candidate seems to be Hulstijn's indifference relation. The same argument I offered above against transitivity can therefore be made in this context. Clearly, there is good reason to assume that (14-b) and (14-c) are stipulative requirements that lack conceptual motivation; in addition, I have at the very least cast doubt on whether (14-d), natural language questions, provide a good motivation for partitions. It seem therefore that a revision of Lewis's definition of relatedness might be in order, and it would be interesting to see what consequences that shift might have.

In summation, transitivity of the indifference relation our query models try to capture is unwarranted from a conceptual perspective, and perhaps should be dropped. If we do that, however, we cease to have an equivalence relation, and partitions are no longer guaranteed to exist.

1.2 Inquisitive Semantics

Inquisitive semantics is a reaction to the issues raised above. First, it makes no syntactic distinction between declaratives and interrogatives, defining a powerful language that can express a full gamut of hybrid sentences that both provide information and raise issues; this makes the logic that corresponds to it a simple system, with most expected logical properties. Second, inquisitive semantics is a strictly more expressive system than a partition-based one, providing the straightforward account of conditional questions sketched above, as well as a whole new class of meanings that, I will argue, are needed to model certain natural language meanings. Third, it takes Hulstijn's (1997) compelling idea of interpreting query languages in structured models that represent a relation of *indifference* and makes it conceptually sounder, by dropping the requirement of transitivity and thereby that of partitions.

1.2.1 An inquisitive program — questions meet disjunctions

Hamblin's (1958) intuition of what a question should mean can be paraphrased as follows.

(15) A question introduces a number of *alternatives* (its possible answers) and requires that one of them be chosen.

This idea is strikingly similar to the way Grice (1989) addresses natural language (or at least English) 'or':

> A standard (if not *the* [PG's emphasis] standard) employment of 'or' is in the specification of possibilities (one of which is supposed by the speaker to be realized, although he does not know which one).

That is, both questions and disjunctions raise possibilities, or alternatives, and convey ignorance of the speaker as to which one is the case. Indeed, it seems that 'or' might even share with questions the requirement that the issue of which of the alternatives is the case be addressed. For example, the dialog below is perfectly natural:

(16) A: John or Mary will come to the party tonight.
B: Well, John is sick, so I guess it's Mary that's coming.

In (16), B is clearly not going off on a tangent by addressing the issue of which one of John and Mary will come to the party, in fact B is perceived as being rather cooperative: B understood A's statement as expressing (among other things) ignorance and interest, and addressed it as though it implied the question "Who will come to the party, John or Mary?"

I will call the sense in which questions and disjunctions are similar their *issue-raising potential*, and will assume it to be located in the semantics instead of the pragmatics. This is by no means a trivial move, but it is justified by the fact that the alternatives put forth by both questions and disjunctions have semantic import, combined with the following postulate of inquisitive semantics:

(17) Semantic alternatives are a result of the linguistic mechanism of raising issues.

That alternatives play a role in the *semantics* of questions was part of Hamblin's (1958) postulates, and it is by now part of the consensus among semanticists. As for disjunctions, recent literature on alternative semantics that deal with, among other linguistic phenomena, free choice and counterfactual sentences with disjunctive antecedents have argued very convincingly for the need for semantic alternatives generated by natural language disjunctions.[9]

The postulate in (17) proposes that we relate the alternative-generating power of questions and disjunctions to their issue-raising potential, illustrated in the example above for disjunction, incontrovertibly present in questions.[10]

If these observations are on the right track, then the meanings of questions and disjunctions ought to be to a visible extent similar.

The main postulate of inquisitive semantics says that we should take this similarity to its direst consequences, by assuming that questions are, at a fundamental level of semantic analysis, disjunctions. Specifically, in the inquisitive propositional language to be defined in a few paragraphs, I will use the abbre-

[9] But see Chemla (2009) for arguments against a semantic treatment of such phenomena.

[10] There are at least two other alternative-generating classes of elements in natural language, namely indefinites (Kratzer and Shimoyama, 2002) and focused constituents (Rooth, 1985). I will briefly mention indefinites later in the very last section of this chapter, arguing that they can be seamlessly integrated into the program of inquisitive semantics. As for focus, it has been discussed in connection with inquisitive semantics by Balogh (2009).

viation

$$?\varphi := \varphi \vee \neg\varphi \ .$$

Although this simple move,[11] as the sections to come will show, allows us to address all the issues raised above against the partition theory, it deserves some immediate clarification.

The central claim is that, at the deepest level of semantic meaning, questions and disjunctions make use of the same semantic mechanism, that of introducing alternatives. This mechanism, I further argue, originates from natural language 'or' and is used by natural language interrogatives, whence my defining a question operator in terms of basic disjunction, and not the other way around.

One way to materialize this insight in our semantics would be to keep it in the meta-level: I could give definitions of disjunction and interrogation that involve the same mechanism at the meta-level, but that instantiate that mechanism differently. The inquisitive semantics and logic I define in this thesis however goes beyond that.

More than just claiming that the alternative-generating mechanism behind questions and disjunctions is the same, inquisitive semantics proposes that this insight be made explicit at the object level. That is, I propose that we define questions *in terms of* disjunctions, as per the abbreviation above. This means that I am taking the similarity between questions and disjunctions to mean quite literally that one class of meanings is derived from the other.

This may seem quite radical. Surely, natural language interrogative sentences are very different from declarative disjunctions, their syntax is different, their intonation patterns are different, and their uses, if not also their meaning, are not identical. The inquisitive semantics and logic instantiated in this thesis, to the extent that it overlooks those differences, is most likely an overly radical idealization, but it is one that, I will show, addresses all the issues raised above while incorporating an insight into the common properties of questions and disjunctions in its most literal interpretation. The differences that exist between natural language interrogative sentences and natural language disjunctive sentences do not invalidate this inquisitive program, they just suggest that further refinements will almost certainly be in order, surely at the syntactic and pragmatic levels, possibly also at a semantic level. It may well turn out that the significance of the similarities pointed out above must be obscured at the object-language level, because of the possible need to differentiate the semantics of interrogation and disjunction to a point where, in the object level definitions, the relation between the two is no longer visible. My stance on that matter is simple: I will begin by investigating the idealized system where the similarity between questions and disjunctions is taken to be identity, or rather inter-definability, and I will leave inquiry on why that is an overly radical hypothesis and how it should be weakened to future research. At the very least, the inquisitive semantics and logic studied here will give insights on the relation

[11]Probably because it is so simple, it is not exactly unprecedented. Harrah (1961) argues that "a logic of questions, sufficient for the question-and-answer process, already exists within the logic of statements." He proposes the abbreviation $F?$ for $F \vee \neg F$, and defines a direct answer to a question $F?$ as any of the disjuncts of $F?$. Harrah's idea was dismissed by Hamblin (1963) as falling in the general category of theories that try to reduce questions to assertions, an enterprise Hamblin found completely misguided. Although I agree with Hamblin regarding the need for a true erotetic semantics, it is not as obvious to me as it was to him that Harrah's research program was incompatible with that basic desideratum.

between questions and disjunction that will inform more linguistically tenable analyses of natural languages.[12]

Moreover, even if it turns out that the level of analysis at which the semantics of natural language interrogatives and disjunctions is the same is so deep as to become almost invisible at the surface level, and only of potential explanatory interest from an historical, diachronic perspective on language, the gain in logical tractability and expressive power that we get from the inquisitive logic I define here makes it worth recognizing and taking seriously what questions and disjunctions share.

The central claim of inquisitive semantics has linguistic motivation independent of the semantic and pragmatic parallels I introduced above. It is well known that very many natural languages share the same morpheme (or close variations thereof) for 'or' and question particles. Malayalam *oo* (Jayaseelan, 2004, 2008) is a good example:

(18) John-oo Bill-oo wannu.
John-or Bill-or came
'John or Bill came.'

(19) Mary wannu-oo?
Mary came-or
'Did Mary come?'

This is a very robust linguistic fact, true of languages like Japanese (*ka*), Korean (*na*) and a number of Slavic languages (*li*). To some extent, such familiar languages as Dutch and English also instantiate this morphological generalization. In Dutch, the embedded question complementizer is identical to the word for 'or', as shown below, and clearly English 'whether' is 'wh' + 'either', a disjunction morpheme.

(20) Ik heb Anne of Marie gezien.
I have Anne or Marie seen
'I saw Anne or Marie.'

(21) Ik weet niet of Anne komt.
I know not or Anne comes
'I don't know if Anne is coming.'

Inquisitive semantics has the potential to straightforwardly account for this observation, since it relates questions and disjunctions in its object language. In other words, taking these linguistic data at their face value most naturally induces, at least as an initial working hypothesis, a semantic move of the sort made in inquisitive semantics.[13]

In the next section, I will define a minimal instantiation of the inquisitive program, the system InqL, and show how it addresses the issues raised in the previous sections.

[12]These paragraphs benefited greatly from a discussion of a closely related topic with Anna Szabolcsi, for which I'm very grateful.

[13]It is important to keep in mind though that the inquisitive logic defined here is rather unsuited for sophisticated semantic work, the main reason for that being that this thesis concentrates exclusively on *propositional* inquisitive logic. See however AnderBois (2009) for an analysis of Yukatek Mayan questions and disjunctions in terms of the logic defined in this thesis.