How specific is a fact? [1]

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1. Worldly Facts

There are at least two areas in semantics where we need facts that cannot be identified with true propositions. One is the semantics of the verb 'to know'. The other is the semantics of counterfactuals. But if facts are not just true propositions, what kind of creatures could they be?
Some scholars think that facts are things in the world like sticks and bricks. Take Charles Baylis.

> 'In the case of ordinary empirical knowledge these facts are fully concrete and particular. Going out in a rainstorm, for example, we become acquainted with some few aspects of the highly complex fact of fully particularised rain falling in a completely particularised way. Though we notice, and perhaps talk about, only certain features of this complex particular event, we believe that it has an indefinitely large number of characteristics. It is raining at a definite rate. Each raindrop is of a definite size and composition. The condition of the clouds above and of the ground beneath is also determinate. The spatio-temporal relations of each raindrop to every other object in the world is specific. There seem always to be further questions about the rainstorm that can be asked.'[2]

On this view, facts are particulars. They are in the world like you and me. They are not at all like propositions. Propositions apply to facts as properties apply to things. Facts exemplify propositions as things exemplify properties.

> '.....and these facts embody or exemplify the abstract propositional meanings they make true. The relation meant by the term "exemplify" is the one commonly signified in the literature of symbolic logic by "$\in$". The relation symbolised by "characterise" is the converse of the epsilon relation.' [3]

2. Worldly facts in a situation semantics

If facts are particulars, they are parts of worlds. We may think of them as situations, provided we think that situations are particulars as well. In what

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[2] Baylis 1948, p.459.

[3] Baylis, op. cit., p.460.

follows, I want to show first how worldly facts can be couched in the situation semantics of Kratzer 1989. I will then argue that such facts play an important role in the semantics of the verb 'to know'. The final part of the paper will establish that we cannot get away with worldly facts alone. Worldly facts have closely related propositional analogues that seem to be needed in the semantics of counterfactuals.

2.1. Outline of a situation semantics

This section presents an overview of the situation semantics of Kratzer 1989. The exposition is necessarily short, giving just about the minimum amount of information to make the paper self-contained. A much more detailed discussion can be found in the original paper.

Situations and individuals

Let us start with the set S of all possible situations. Possible situations are (not necessarily proper) parts of possible world histories, possible worlds extending through time.[4] We may take situations as basic irreducible entities.[5] A subset A of S is singled out as the set of possible individuals (including the temporal parts of possible individuals).

The members of S are all particulars. Consider this shirt. It is striped in a very particular way. This very particular way of being striped is an actual state of my shirt. It is a state so particular that it is a state that only my shirt can be in. Its particular way of being striped is just one of the states of my shirt. There are others. Its very particular way of being cotton, its very particular way of being as long as it is, and its very particular way of being from Italy. All of those states are fairly permanent. But there are also the fugitive states of my shirt's temporal parts. Its very particular spinning in the washing machine this morning. Its very particular drying on the line. Its very particular way of being folded and placed in the drawer.

I want to suggest that such particular states are the possible situations that are the building blocks for possible worlds.

The part-whole relationship

Situations stand in part-whole relations to each other. The part-whole

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[4] In Kratzer 1989, I follow Barwise & Perry 1983 in assuming that actual situations are particulars and are parts of the actual world. As for merely possible situations, I assume that they are parts of possible worlds just like actual situations are parts of the actual world. My general view of possible worlds and their parts is the one defended in Lewis 1986. For an overview of some of the choices to be considered in Situation Theory, see Barwise 1989.

[5] This view is taken in Barwise & Perry 1983 for actual situations. Kratzer 1989 tries to analyze situations further borrowing some ideas from David Armstrong. I am not convinced that this attempt was successful, in particular in view of objections raised in Lewis 1986a and 1986b.

relationship $\leq$ is a partial ordering on S satisfying at least the following additional condition:

For all $s \in S$ there is a unique $s' \in S$ such that $s \leq s'$ and for all $s'' \in S$, if $s' \leq s''$, then $s'' = s'$.

The above condition states that every possible situation s is related to a unique maximal element w_s, the world of s. This means that no possible situation can be part of more than one possible world. Situations cannot 'grow' into different possible worlds, just like my hands cannot 'grow' into different possible bodies. It also follows that individuals and temporal parts of individuals cannot be in more than one world. They may be related across possible worlds via a counterpart relation as proposed in Lewis 1968 and 1986.
The set of all maximal elements with respect to the ordering $\leq$ is the set W of possible worlds.
Our situations are as specific as you can ever get. We should not confuse them with information states.[6] A maximally specific information state is also a maximal information state, an information state not properly contained in any other information state. The members of S are always maximally specific without having to be maximal with respect to $\leq$.

Propositions
Any set of possible situations is a proposition. Propositions, then, classify situations. They are properties of situations.[7] A proposition p is true in a situation s if and only if s is a member of p. If p is not true in s, then p is not necessarily 'false' in s. It may be that p is 'not yet' true in s, but will become true in some situation of which s is a part.
Some sets of possible situations are propositions graspable by humans. Some propositions that are graspable by humans are propositions expressible by utterances of sentences in natural languages. The latter kind of proposition is the kind that I will be interested in in what follows. Kratzer 1989 argues that all propositions expressible by utterances of sentences in natural languages obey certain constraints. One such constraint is persistence. That a proposition is persistent means that whenever it is true in a situation s, it is true in any situation of which s is a part.
The meanings of declarative sentences are not propositions, but functions from

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[6] see Landman 1986, and Veltman 1985.

[7] I am following Barwise and Perry in assuming that simple indicative statements describe types of situations. But I construe situation-types as sets of possible situations rather than as partial functions from n-ary relations and n individuals to the values 1 and 0.

utterance situations to propositions.[8] For ease of exposition, I will neglect any context dependency, however, and do as if the meanings of sentences were simply propositions. Here are some illustrations. The meaning of the (tenseless) sentence 'Socrates is in prison' is the set of all possible situations in which some temporal stage of Socrates (or of one of his counterparts) is in prison. The meaning of the sentence 'Socrates is in prison now' is the set of all possible situations in which the present temporal stage of Socrates (or of one of his counterparts) is in prison.
The logical relations depend only on the possible worlds in which propositions are true. A proposition p logically implies a proposition q, for example, if and only if $p \cap W \subseteq q \cap W$. This ensures that the semantics is ultimately classical.

2.2. Facts that make propositions true. A definition

Given a proposition p and a possible situation s, we may ask whether p is true in s. This question is easy to answer. The answer is 'yes' just in case s is an element of p. But there is a second question that is harder. Is s a fact that makes p true? The proposition expressed by the (tenseless) sentence 'Socrates is in prison' is true in any possible situation in which some temporal stage of Socrates (or of one of his counterparts) is in prison. I don't want to say that all of those situations are facts that make the proposition expressed by 'Socrates is in prison' true. A situation in which a proposition is true may contain a lot of aspects that are irrelevant to the proposition's truth. I suggest that a fact that makes a proposition p true is a situation that contains no aspects irrelevant to the truth of p. Here is a definition capturing this intuition.

Facts that make propositions true
If s is any situation and p any proposition, then s is a fact that makes p true iff for all s' such that $s' \leq s$ and $s' \notin p$, there is an s" such that $s' \leq s'' \leq s$, and s" is a minimal situation in which p is true. (A minimal situation in which p is true is a situation that contains no proper part in which p is true as well.)

It follows from the definition above that a fact that makes p true is always a situation in which p is true (that is, a p-situation). But it is not just any old p-situation. It is a p-situation that contains no parts that are irrelevant to the truth of p. Such a situation may have a lot of parts in which p is true. Maybe p is even true in all its parts. But whenever it contains a part in which p is not true, this part must at least contribute to the truth of p. A situation in which p is not true contributes to the truth of p if it is part of a minimal situation in which p is true. This is so since a minimal situation in which p is true cannot have any parts that are irrelevant to the truth of p.
The following section illustrates how the definition applies to different kinds of

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[8] See Kaplan 1977.

propositions.

2.3. Facts that make propositions true. Illustrations

Consider the (atelic) proposition **[[1]]** expressed by the following (tenseless) sentence.

(1) **Mary is out of town.**

The proposition **[[1]]** is true in any possible situation in which a temporal part of Mary (or of one of her counterparts) is out of town. Suppose Mary was out of town only once in the actual world. If she stayed out of town for some time, that's enough for there to be many facts that make **[[1]]** true. If Mary was out of town for five weeks, there is a chunk of our world that consists of a five week slab of Mary and whatever it is in our world that realizes her particular five week absence. This chunk is a fact that makes **[[1]]** true according to the definition given above. The big chunk has parts that are also facts that make **[[1]]** true. One week chunks, one day chunks, one hour chunks, and what have you. Hence there are many facts that make **[[1]]** true in the actual world. This seems at odds with our assumption that Mary was out of town only once. Note, however, that many of the facts that make **[[1]]** true are related by the part-whole relationship. It is well known that we have to be careful with counting in those cases. Suppose that someone claims:

(2) **There is only one place in the whole world where one can eat well, and that's the 'Student Prince'.**[9]

Strictly speaking, this is not true. If you can eat well in the 'Student Prince', you might also eat well in its Heidelberg Room. And you will certainly be able to eat well in Springfield, in Massachusetts, in the United States, and so on. When we talk about 'the only' place where you can eat well we assume that places of restaurants are salient options for our domain of quantification.
Likewise, we have to make a choice when talking about the facts that make **[[1]]** true. In our case, a natural choice are the maximal facts that make **[[1]]** true. If Mary was out of town only once, then there is exactly one such maximal fact. If she was out of town several times, there are several maximal facts that make **[[1]]** true. In this way, we end up with one fact per absence, and this is as it should be.[10]
Let us now look at the (telic) proposition **[[3]]** expressed by the following (tenseless) sentence.

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9 The 'Student Prince' is a restaurant in Springfield, Massachusetts.

10 See Bach 1981.

(3) **Mary drinks a glass of water.**

The proposition **[[3]]** is true in any possible situation in which Mary drinks a glass of water. Suppose it only happened once that Mary drank a glass of water in the actual world. Then there is exactly one minimal situation in which Mary drinks a glass of water. That's already a fact that makes **[[3]]** true according to my definition. And it's the only fact that makes **[[3]]** true. Suppose Mary drinks two glasses of water, one right after the other. Then we have three facts. One contains the other two as parts. I think this is right. If I had to count the facts that make **[[3]]** true, I would have a choice. Was it one fact or two? If Mary drinks a glass of water, then pauses for a while and drinks another one, we clearly have two facts that make **[[3]]** true.
The definition above may appear problematic in view of propositions like the one expressed by the following sentence.

(4) **There are infinitely many parasites.**

If the proposition expressed by (4) is the proposition **[[4]]** that is true in any possible situation in which there are infinitely many parasites, we are in trouble. The definition predicts that there cannot be a fact that makes **[[4]]** true. Whenever **[[4]]** is true in a situation s, then s has parts in which **[[4]]** is not true. Situations with five or six fleas, for example. But these situations are not part of any minimal situation in which **[[4]]** is true.
I don't think that this case is beyond repair. We don't have to accept that the proposition expressed by (4) is **[[4]]**. There is a slightly different way of understanding (4). The German sentence (5) brings out this reading clearly.

(5) **Parasiten gibt es unendlich viele .**
Parasites are there infinitely many .
As for parasites, there are infinitely many of them.

In (5), the common noun 'Parasiten' has been topicalized. (5) makes a claim about all parasites there are. It states that the number of all parasites is infinite. Following the reasoning of Kratzer 1989, the proposition expressed by (5) is true in a situation s iff s contains all the parasites of the world of s, and they are infinite in number. If this proposition is true in a world, there is always a minimal situation in which it is true, hence there is always a fact that makes it true.
Our next example is a disjunctive sentence (again understood in a tenseless way).

(6) **Mary reads 'Middlemarch' or sees 'Wings of Desire'.**

[[6]] is true in a possible situation s if and only if Mary reads 'Middlemarch' in s

or sees 'Wings of Desire' in s. If only the first disjunct is true in the actual world, and if Mary reads 'Middlemarch' only once, then the fact that makes **[[6]]** true in the actual world is the minimal situation in which Mary reads 'Middlemarch'. If only the second disjunct is true, similar considerations apply. And if both disjuncts are true, then there are at least two facts that make **[[6]]** true in our world.
Negated sentences are difficult. Let us look at an example.

(7) **Mary isn't in ASHFIELD.**

(7) is a sentence in which the noun 'Ashfield' is focused. In Kratzer 1989, I argued that negation in English usually associates with focus, and that the logical form for (7) is (7').

(7') **[Not x: Mary is in x] Mary is in Ashfield**

Logical representations like (7') are interpreted as follows (α and β are sentences, g is a variable assignment, and s is a situation) :

$s \in$ **[[** [**Not x:** α] β **]]**^{g} iff

(i) For all x-alternatives g' of g: Whenever $w_s \in$ **[[** α **]]**$^{g'}$ then $s \in$ **[[** α **]]**$^{g'}$ and

(ii) $s \notin$ **[[** β **]]**^{g} .

This means that if Mary is in Conway, then this is a fact that makes **[[7]]** true. If she is in Apple Valley, then this is a fact that makes **[[7]]** true, and so on. Consider next the following variant of (7). (8) is like (7), except that 'Mary' is focused rather than 'Ashfield'.

(8) **MARY isn't in Ashfield.**
(8') **[Not x: x is in Ashfield] Mary is in Ashfield**

Suppose Ann, Noah, Catherine, and Joseph are all the people that are in Ashfield. This fact is then a fact that makes **[[8]]** true (**[[8]]** is true in any situation that contains everybody who is in Ashfield in the world of s, provided Mary is not one of them).
[[7]] and **[[8]]** are logically equivalent propositions. They are true in the same possible worlds, though not in the same possible situations. As a consequence, negation comes out as classical as far as possible worlds are concerned.

3. Facts and the semantics of 'to know'

We are now in the position to take up the semantics of the verb 'to know'. was a time when it seemed common wisdom that knowledge is justified true belief. This view has been thoroughly refuted by Edmund Gettier.[11] I am going to argue for a slightly different view. This is the view that knowledge is justified belief of facts. If facts are identified with true propositions, the two views don't seem to be different, of course. But if we adopt the worldly view of facts, a very different picture emerges.

3.1. Alvin I. Goldman

In "A Causal Theory of Knowing", Alvin I. Goldman proposes the following truth-conditions for knowledge ascriptions.

Knowledge

'S knows p if and only if the fact p is causally connected in an "appropriate" way with S's believing p.'[12]

The definition is designed to cope with Gettier's examples showing that knowledge is not justified true belief. Some notions in Goldman's definition need further thought. While Goldman explores possibilities for appropriate causal connections [13], he takes the notion 'fact that p' for granted. What is a 'fact that p'? Looking at one of Gettier's examples and an example by Russell reveals that the facts figuring in these examples must be highly specific, whereas the beliefs involved are much more general. This is what seems to cause that kind of puzzle.

3.2. Russell. A case with a definite NP

Let us first look at Russell's example.[14]

> 'If a man believes that the late Prime Minister's name began with a B, he believes what is true, since the late Prime Minister's last name was Sir Henry Campbell Bannerman. But if he believes that Mr. Balfour was the late Prime Minister, he will still believe that the late Prime Minister's last name began with a B, yet this belief though true, would not be thought to constitute knowledge.'

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[11] Gettier 1963.

[12] Goldman 1967. Reprinted in Davis 1983, p.150.

[13] He does not see the connection with *de re* belief, however.

[14] Russell 1912. Quoted from the1959 Oxford University Press paperback edition, p.131 f. This example is not a Gettier example, since the man is not necessarily justified in believing that the late Prime Minister's last name began with a 'B'. This point is not relevant here, however.

Suppose the believer's name is 'Jones', and consider the following sentences.

(9) **Jones knows that the late Prime Minister's name began with a 'B'.**

(10) **The late Prime Minister's name began with a 'B' .**

Applying our notion of 'fact' to Goldman's definition we get the following. **[[9]]** is true (in the actual world), if and only if Jones believes that the late Prime Minister's name began with a 'B' and the fact that the late Prime Minister's name began with a 'B' is causally connected in an "appropriate" way with Jones's belief that the late Prime Minister's name began with a 'B'. Now every real world situation in which the late Prime Minister's name begins with a 'B' is a situation in which Sir Henry Campbell Bannerman is the late Prime Minister. This means that the actual facts that make **[[10]]** true are all situations in which Henry Campbell Bannerman is the late Prime Minister. But then the fact that makes **[[10]]** true[15] is not connected in any way to Jones's belief. Hence Jones doesn't know that the late Prime Minister's name began with a 'B'.

3.3. Gettier. A case with 'or'.[16]

One of Gettier's two examples roughly goes as follows. Smith has strong evidence for the proposition expressed by (11).

(11) **Jones owns a Ford.**

Smith's evidence is that Jones has owned a Ford for many years and has just offered Smith a ride while driving a Ford. Smith has another friend, Brown, of whose whereabouts he is totally ignorant. Smith selects a place name at random and constructs the following sentence.

(12) **Either Jones owns a Ford, or Brown is in Barcelona.**

The proposition expressed by (11) logically implies the proposition expressed by (12). Smith is aware of the entailment, and accepts (12) on the basis of (11). But unknown to Smith, Jones doesn't own a Ford but is driving a rented car. And by sheer coincidence, Brown is in fact in Barcelona. On this scenario, Smith believes the proposition expressed by (12), he is justified in believing it, and it is true. Yet the proposition expressed by (13) is false.

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[15] that is, the maximal fact that makes [[13]] true.

[16] Gettier 1963. Reprinted in Davis 1983,135-137.

(13) **Smith knows that either Jones owns a Ford, or Brown is in Barcelona.**

Couched in our framework, Goldman's definition yields the following. Every actual situation in which **[[12]]** is true is a situation in which Brown is in Barcelona. Hence the fact that makes **[[12]]** true is a situation in which Brown is in Barcelona. But there is no connection between this situation and Smith's belief.

3.4. Goldman reformulated

The discussion of the above examples showed that in knowledge ascriptions, the 'that'- clause has a double function. One is to characterize the information content of the belief ascribed. In the simplest cases, the information content of the belief ascribed is the set of possible situations in which the proposition expressed by the 'that'-clause is true.[17] But the 'that' -clause also characterizes a fact that the belief ascribed is a belief of. It helps pick out the *res* of the belief. This *res* is not a proposition. It is a worldly thing, a situation.

In Gettier's example, the information content of Smith's belief is the set of all possible situations in which Jones owns a Ford or Brown is in Barcelona. But there is no actual fact that Smith's belief is a belief of. It can't be the fact that Brown is in Barcelona, since Smith is not connected to this fact. Smith thinks he is connected to the fact that Jones owns a car. So he thinks he knows. But since there is no such fact, he doesn't know.

What is it that makes a belief a belief of something in the world? This question has been discussed widely. Modern accounts agree that for a belief to be a belief of something in the world, the belief and the thing in the world have to be connected in an appropriate way. David Kaplan requires some causal rapport between believer and *res*, and David Lewis requires a relation of acquaintance, for example.[18] Leaving open what the appropriate connection is, I'd like to suggest that the connection relevant for knowledge is whatever connection is involved in *de re* belief. This leads us to the following reformulation of Goldman's definition.

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[17] The relationship between the 'that'-clause and the information content of the belief ascribed is not trivial. See Cresswell 1985 for extensive discussion. And the information content of beliefs may not be propositions at all. See Lewis 1979. I will ignore these complications in what follows. I don't think they affect the essence of the point I want to make.

[18] Kaplan 1968, Lewis 1979. A useful collection of papers on causal accounts of reference, knowledge, perception, and memory is Davis1983.

Knowledge [19]
S knows p in a world w if and only if the following three conditions are satisfied for some f such that f ≤ w :

(i) f is a fact that makes p true
(ii) in w, S believes p *de re* of f
(iii) some suitable justification or reliability condition[20].

This definition of knowledge is very much like the classical definition. It has the familiar three conditions. One requiring truth, one requiring belief, and one requiring justification. The crucial difference is the belief condition. The belief condition requires S to believe p *de re* of a fact. This means that for S to know p there must be a fact f such that S reliably ascribes the property p to f (remember that propositions are properties of situations, and that facts are situations). Goldman's 1967 definition has no justification condition. That a justification condition is needed in addition to conditions (i) and (ii) is shown by the following example from Goldman 1976.[21]

'Henry is driving in the countryside with his son. For the boy's edification Henry identifies various objects on the landscape as they come into view. "That's a cow", says Henry, "That's a tractor", "That's a silo", "That's a barn", etc. Henry has no doubt about the identity of these objects; in particular, he has no doubt that the last-mentioned object is a barn, which indeed it is. Each of the identified objects has features characteristic of its type. Moreover, each object is fully in view, Henry has excellent eyesight, and he has enough time to look at them reasonably carefully, since there is little traffic to distract him.
Given this information, would we say that Henry *knows* that the object is a barn? Most of us would have little hesitation in saying this, so long as we were not in a certain philosophical frame of mind. Contrast our inclination here with the inclination we would have if we were given some additional information. Suppose we are told that, unknown to Henry, the district he has just entered is full of papier-mache facsimiles of barns. These facsimiles look from the road exactly like barns, but are really just facades, without back walls or interiors, quite incapable of being used as barns. They are so cleverly constructed that travelers invariably mistake them for barns. Having just entered the district, Henry has not encountered any facsimiles; the object he sees is a genuine barn. But if the object on that site were a facsimile, Henry would mistake it for a barn. Given this new information, we would be strongly inclined to withdraw the claim that Henry *knows* the object is a barn. '

On this scenario, Henry is visually related to a situation f and he correctly classifies f as a situation in which there is a barn. He has a correct *de re* belief of f. Yet he doesn't know of f that f is a situation with a barn. The reason seems

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[19] For simplicity's sake, I give the truth-conditions for 'to know' with respect to worlds only.

[20] I am not committing myself to any particular formulation of this condition, but will motivate the necessity of such a condition below.

[21] Goldman 1976. Reprinted in Davis 1983, p. 175 f.

to be a lack of discrimination abilities. Henry doesn't reliably ascribe the property 'there is a barn' to f, since he isn't able to discriminate between this property and the property 'there is a fake barn'. While we usually don't require discriminatory abilities as fine-grained as that, in Henry's case they would be relevant. What is relevant is highly context-dependent of course. If the fake barns are further away, or just a possibility mentioned by a nearby sceptic, our intuitions start fading away. Our ascriptions of knowledge, then, are affected with vagueness. This is why scepticism is such a tenable position.
Is knowledge always *de re* belief of facts? Here is a potential counterexample.

3.5. Knowledge of non-accidental facts

You know that someone was born yesterday. And it's true. Ashley, Beverly, and Kimberley were all born yesterday. You don't know about any of those births. Nor do you know of any other births. Then it seems that there is no fact to which you ascribe the property of being a situation in which someone was born. But still you know. How come? It's easy to know that sort of thing. We know that someone is born every day. And from this, we infer that someone was born yesterday. So we know that someone was born yesterday. Seen in this way, the fact that someone was born yesterday is a non-accidental fact of our world. Kratzer 1989 proposes a semantic distinction between accidental and non-accidental generalizations that has the effect that an accidental generalization and its non-accidental counterpart are true in the same possible worlds, but not in the same possible situations. For our example, the intuition behind the distinction amounts to this. A sentence like

(14) **Someone was born yesterday.**

is ambiguous in a very subtle way. It may characterize birth situations. On this (accidental) reading, the proposition it expresses is the set of all possible situations that include a situation whose temporal location is yesterday, and in which someone was born. The actual facts that make the proposition expressed by (14) true on our scenario, are then the births of Ashley, Beverly, and Kimberley, provided that these were the only births that occurred yesterday. But there is another reading. On the non-accidental reading, the proposition expressed by (14) classifies worlds, not situations. It characterizes the set of worlds in which births occurred yesterday. Formally, it is the proposition that is true in any situation s if and only if s is part of a world that contains a situation whose temporal location is yesterday, and in which somebody is born [22]. This proposition is true in all or none of the situations of a world. If it is true in a world at all, each and every situation of that world is a fact that makes it true. Taking the maximal facts to be the relevant facts, we get the result that the facts that

[22] See Kratzer 1989.

make the non-accidental proposition expressed by (14) true are always worlds. To know a non-accidental generalization in the actual world, then, means to have a justified true *de re* belief of the actual world. But ascribing a property to the actual world is the easiest thing for us to do. We are all intimately connected to the world we live in. This means that with non-accidental generalizations, the belief condition is not hard to satisfy. The main burden, then, falls on the justification condition.
If the proposition Gettier's Smith thinks he knows is accidental, Smith doesn't know since the belief condition fails. If it is non-accidental, however, the belief condition is almost trivially satisfied. But then Smith has to be justified in taking the proposition to be a non-accidental generalization. But he is not.
Kratzer 1989 discusses sentence types that express propositions that can only be true in worlds. Examples are counterfactuals and sentences with sentential negation. The facts that make such propositions true, then, are always worlds. This means that for knowing such propositions, justification is again crucial. And in those cases, too, the belief condition is easily satisfied.

3.6. Knowledge of the future

Can we have knowledge of future accidental facts? Sometimes we can. Sometimes we can't. Take Brian Skyrms's example.[23]

> 'Consider a society that knows how to construct barometers but is ignorant of the meteorological theories relevant to their uses. Suppose, however, that it has been observed that falling barometers have always been a reliable preindicators of impending rain. And suppose that an individual X observes a barometer falling and thus believes that it will rain, and that it does, in fact, rain. Then his belief is true, and, by the usual canons of evidence, justified. But suppose further that *in this case* the barometer did not fall because of falling air pressure, but because the internal mechanism went haywire. Thus there was no causal relation, *in this instance*, between the action of the barometer and the impending rain, although we shall assume that in the previous observed instances which established barometers as reliable preindicators, the barometers were in good condition, and there was an underlying causal connection. I assume that we would all agree that X did not *know* that it was going to rain. In this instance, he was just lucky. '

As long as there are preindicators of accidental future facts, we can have *de re* beliefs of them. Barometers are good preindicators of future weather facts. Provided they work. In Skyrms's example, the barometer was defective. It didn't indicate the future rainfall. Hence it didn't connect X to this fact. Hence X lacked knowledge. The belief condition failed.

4. Facts and counterfactuals

Construing facts as things in the world gave us suitable entities for the semantics of factive verbs like 'to know'. For the semantics of those verbs it is

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[23] Skyrms 1967. Reprinted in M. D. Roth & L. Galis 1970, p.102.

wise to assume that facts are particulars. In this section, I will show that the facts involved in counterfactual reasoning seem to be almost equally specific. But those facts must be propositions. They cannot possibly be things in the world. If this is right, there must be a way of construing facts as highly specific propositions.

4.1. An analysis of counterfactuals [24]

For the semantics of counterfactuas, I will assume a 'premise' analysis as proposed in Veltman 1976 and 1985, and Kratzer 1981.[25] The truth-conditions for 'would' and 'might' counterfactuals are as follows.

'Would'-counterfactuals

A 'would'-counterfactual is true in a world w iff every way of adding as many facts of w to the antecedent as consistency allows reaches a point where the resulting set logically implies the consequent.[26]

'Might'-counterfactuals

A 'might'-counterfactual is true in a world w iff not every way of adding as many facts of w to the antecedent as consistency allows reaches a point where adding the consequent would result in an inconsistent set.

Facts figure prominently in the above truth-conditions. But what kind of facts? If facts are to be compatible or incompatible with propositions, they'd better be propositions themselves. Will just any old true proposition do? No. The following arguments show that the facts that play a role in counterfactual reasoning are highly specific, too. We can show this using examples that are exactly modelled after Russell's and Gettier's examples.

4.2. Examples

Let us first look at a Russell type example.

(15) **If Whitehead had been the late Prime Minister, his name might have started with a 'B'.**

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[24] This is not the place to discuss the exact role of non-accidental generalizations in counterfactual reasoning. For a detailed discussion, see Kratzer 1989. The proposal in Kratzer 1989 needs to be updated and revised, however. The account of 'Goodman's Puzzle' is flawed, for example, suggesting changes in the basic definitions. (Thanks to Irene Heim for pointing this out).

[25] The analysis of Veltman 1976 is based on beliefs, not facts, however.

[26] Counterfactuals can only be true in worlds. See Kratzer 1989.

The counterfactual expressed by (15) is false given Russell's scenario.[27] Yet if facts were simply true propositions, our analysis would predict it to be true. Here is why.[28]

(16) **Whitehead is the late Prime Minister.** (Counterfactual Antecedent)
(17) **The late Prime Minister's name starts with a 'B'.** (Fact)
(18) **Whitehead's name starts with a 'B'.** (Counterfactual Consequent)

The proposition expressed by (16) is the antecedent of our counterfactual. The proposition expressed by (17) is true, hence a fact by assumption. And **[[16]]** and **[[17]]** together logically imply **[[18]]**. Hence every superset of { **[[16]]** , **[[17]]** } logically implies **[[18]]**. This means that there is a way of adding as many facts to the antecedent of our counterfactual as consistency allows such that there will never come a point where adding the consequent would result in an inconsistent set.
A very similar example can be constructed using Gettier's scenario.[29] Consider the following counterfactual.

(19) **If Brown hadn't been in Barcelona, Jones might have owned a Ford.**

The counterfactual expressed by (19) is false on Gettier's story. Yet if facts were just true propositions, it would be predicted to be true, given the following:

(20) **Brown is not in Barcelona.** (Counterfactual Antecedent)
(21) **Jones owns a Ford or Brown is in Barcelona.** (Fact)
(22) **Jones owns a Ford.** (Counterfactual Consequent)

As before, the counterfactual antecedent and the fact mentioned jointly imply the counterfactual consequent. But this is sufficient to predict that **[[19]]** should come out true.
The two examples suggest that the facts involved in the evaluation of a counterfactual must be highly specific. While they have to be propositions, and have to be true, they can't be identified with true propositions. Let us investigate some possibilities.

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[27] Recall that on Russell's scenario, Sir Henry Campbell Bannerman was the late Prime Minister. Hence the late Prime Minister's name started with a 'B'.

[28] Time is neglected here.

[29] Recall that on Gettier's scenario, Jones doesn't own a Ford, and Brown is in Barcelona.

4.3. Propositional facts. Failed attempts.

If f is the fact that makes **[[21]]** true in the actual world, then { f } is a proposition. It is a proposition, but it is not a proposition that I think is expressible by utterances of sentences in any natural language. It is not persistent. Let us consider the smallest persistent superset then. This is $p = \{s : f \leq s\}$. Since f is a fact of the actual world, and p is persistent, the actual world is in p. Since f is only part of a single world, no other world is in p. The proposition p, then, is highly specific. It is only true in actual situations. Is p the kind of propositional fact that we are looking for? Unfortunately, the proposition p is too specific. It is useless for the evaluation of counterfactuals in the actual world. Since the actual world is the only world in p, p is only compatible with propositions that are actually true. But the antecedents of counterfactuals are typically false. Hence p could never be compatible with a typical counterfactual antecedent. Moving closer towards the analysis of Kratzer 1989, we may come up with the following definition of propositional facts.

Propositional facts

A propositional fact of a world w is any proposition p such that

(i) $w \in p$ and

(ii) p logically implies any proposition that it lumps in w.

The lumping relation is defined as follows.

Lumping

A proposition p lumps a proposition q in a world w iff

(i) $w \in p$ and

(ii) for all s such that $s \leq w$: If $s \in p$ then $s \in q$.

As it stands, this proposal fails as well. Here is the proof.[30]

Proof that the proposal goes wrong

Let p be any propositional fact of a world w. Let q be $\{ s: s \in p \ \& \ s \leq w \}$. Then p lumps q in w. Hence p logically implies q, since p is a propositional fact by assumption. This means that $p \cap W \subseteq q \cap W$. But $q \cap W = \{ w \}$. Hence $p \cap W = \{ w \}$. But then p can never be compatible with any proposition that is false in w.

We are now back where we started. Our propositional facts are too specific. The

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[30] The analysis of Kratzer 1989 contains some very general caveats that make it not susceptible to the consequence of the following proof. We may want some less ad hoc provisions, however.

following section explores a route towards a less specific notion of a propositional fact.

4.4. Propositional facts and natural propositions

The above examples showed that the facts involved in the evaluation of a counterfactual in the actual world must be highly specific. Yet they cannot be too specific. They must be capable of being true in merely possible situations. Otherwise they could never be compatible with an assumption that is actually false. Which possible situations are we going to include? Here is a way of thinking about this question.

Let a natural proposition be any persistent proposition that doesn't distinguish between maximally similar situations. Whenever it is true in a situation s, it is also true in any situation that is maximally similar to s. What are maximally similar situations? We may think of maximally similar situations as isomorphic situations very much like the isomorphic worlds of Kit Fine.[31]

'Intuitively speaking, two worlds are isomorphic if they are qualitatively the same, i.e., if they are the same but for the identity of the individuals in the world.'

Take the fact that you worked in the yard yesterday. Take it as a worldly fact. This is a situation. It is a situation in which you pruned my apple tree at five o'clock. Let us say that a merely possible situation is isomorphic to that situation if it is qualitatively the same and preserves counterpart relationships.[32] It can't contain you or my apple tree, since individuals cannot exist in different possible worlds. But it must contain maximally similar counterparts of you and my apple tree. And my apple tree's counterpart must be pruned by your counterpart at five o'clock in a maximally similar way.

To see what it means for a proposition to be natural, let us assume that there is exactly one worldly fact f that makes the proposition expressed by the following (tenseless) sentence true in the actual world.

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[31] Fine 1977. See also Rabinowicz 1979. Thanks to Ede Zimmermann for the references.

[32] Counterpart relationships between individuals are based on overall similarity with respect to worlds, not situations. This guarantees persistence of propositions like the one expressed by 'Thomas is picking roses'. This proposition, then, is the proposition that is true in any situation s iff s contains a rose picking individual that is a counterpart of Thomas in the world of s. If the similarity relation involved in 'naturalness' preserves all counterpart relations, propositions like the one expressed by 'Thomas is picking roses' are guranteed to come out as natural as well. Requiring maximal qualitative similarity alone isn't sufficient since two individuals that inhabit different worlds and are qualitatively indistinguishable in some situations don't have to be counterparts of each other. They may be quite different in other situations, hence lack overall similarity. But then it may happen that a proposition like the one expressed by 'Thomas is picking roses' is true in a situation without being true in all situations that are qualitatively the same.

(23) **Thomas is picking roses.**

Technically, { f } is a proposition, but not a persistent one. The smallest persistent extension of { f } is p = {s : f ≤ s}, the set of all actual situations in which Thomas is picking roses. This proposition is persistent, but not natural. To extend p into a natural proposition, we have to add all situations that are maximally similar to some situation in p. Persistence then forces us to add all situations that contain any one of the recently added situations as parts. Naturalness requires to add all situations that are maximally similar to the situations we just added, and so on. We eventually end up with a set of situations that have one property in common: They are all situations in which an indistinguishable counterpart of Thomas is picking indistinguishable counterparts of actual roses in a way that is indistinguishable from the way Thomas is picking roses in the actual world.
Consider now the following revised definition of a propositional fact.

Revised definition of a propositional fact
A propositional fact of a world w is any proposition p satisfying the following conditions:

(i) w ∈ p and
(ii) Whenever q is natural, and p lumps q in w, then p logically implies q.

This definition prevents propositional facts from necessarily being too specific. It allows the lumping process to stop at the level of natural propositions.[33]
Let us briefly check whether this revised notion of a propositional fact is specific enough for the two examples of counterfactual reasoning I discussed earlier.

4.5. Propositional facts and counterfactuals

Consider the counterfactual version of Russell's example. What went wrong in this example was the possibility of using the proposition expressed by sentence (17) as a fact for the evaluation of the counterfactual expressed by (15). On the new proposal, **[[17]]** is not specific enough to be considered a propositional fact of the actual world. The least specific propositional fact corresponding to **[[17]]**

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[33] Note that any true proposition lumps all non-accidental propositions in a given world (recall that non-accidental propositions are true in all or none of the situations of a world). But since non-accidental propositions are not necessarily natural, this does not mean that any propositional fact of a world implies all non-accidental generalizations of that world.
As it stands, the proposal doesn't give an automatic account of the role of non-accidental generalizations in counterfactual reasoning. The definition admits non-accidental propositions as propositional facts, yet combined with the premise analysis of counterfactuals given earlier, there is no guarantee that non-accidental generalizations will be given priority over accidental ones. This would have to be stipulated separately.

in the actual world is the following proposition p.

p = ∩ { q: q is natural and q is lumped by **[[17]]** in the actual world }

The proposition p logically implies the proposition that Sir Henry Campbell Bannerman is the late Prime Minister. This proposition is lumped by **[[17]]** in the actual world. And it is natural. It is true in any situation in which a counterpart of Sir Henry Campbell Bannerman is the late Prime Minister. But then p cannot be used in the evaluation of the counterfactual expressed by (15), since it is incompatible with its antecedent.
A similar analysis can be given to the counterfactual counterpart of Gettier's example. The least specific propositional fact corresponding to the proposition expressed by (21) is the following proposition.

q = ∩ { p: p is natural and p is lumped by **[[21]]** in the actual world }

The proposition q logically implies the proposition that Brown is in Barcelona , since this proposition is natural and is lumped by **[[21]]** in the actual world. But then q cannot be used in the evaluation of the counterfactual expressed by (19), since it is incompatible with its antecedent.
I conclude that the facts involved in counterfactual reasoning are propositional facts. Propositional facts are sets of possible situations of a highly specific kind. Yet they don't have to be that specific. Propositional facts may allow for possibilities. They may be information units. If we lower the standards for 'maximal qualitatitive similarity', we might even obtain facts that are representable by a human mind .
And this gets us closer and closer to C. I. Lewis's last word on facts.

5. C.I. Lewis's last word on facts

Shortly before his death, Clarence I. Lewis had one last opportunity to defend himself against his student Charles Baylis.[34]

'Charles Baylis is minded to pin a theory of fact on me, taking advantage of a momentary lapse of my verbal defense-mechanisms in an old article. I account this pure wickedness on his part; he knows that 'fact' is one of the trickiest words in any language; and he knows that I know it. But I shall foil him yet: I shall now pronounce the final and authoritative Lewis theory of fact. A fact is an actual state of affairs. But 'fact' is a crypto-relative term, like landscape'. A landscape is a terrain, but a terrain as seeable by an eye. And a fact is a state of affairs, but a state of affairs as knowable by a mind and stateable by a statement.'

[34] C. I. Lewis 1968, p. 660.

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