

Counterfactuals in Context: Felicity conditions for counterfactual conditionals containing proper  
names

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**Abstract**

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This thesis provides felicity conditions for counterfactual conditionals containing proper names in which essential changes to an individual are counterfactually posited using contrastive focus in either the antecedent or consequent clause. The felicity conditions proposed are an adaptation of Heim's (1992) CCP Semantics into Kratzer's (1981) truth conditions for counterfactual conditionals in which the partition function  $f(w)$  serves as the local context of evaluation for the antecedent clause, while the set of worlds characterized by the antecedent serves as the local context for the consequent clause. In order for the felicity conditions to generate the right results, it is shown that they must be couched in a rigid designator/essentialist framework inspired by Kripke (1980). This correctly predicts that consequents containing rigid designators are infelicitous when their input context—the set of worlds accessible from the antecedent clause—does not contain a suitable referent.

## Introduction

We use counterfactual conditionals like (1a-b) to make claims about the “ways things could have been,” not about the way things actually are<sup>1</sup> (Lewis 1973, p.84). The antecedent clause of a counterfactual conditional posits a change to the actual world from which the consequent clause would/might follow. For example, when uttered in a context in which it is known that Bill is Mary’s roommate, the antecedent of (1a) counterfactually supposes that John had been Mary’s roommate *instead*<sup>2</sup>.

(1) Bill is Mary’s roommate.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>’s roommate, she<sub>1</sub> would/might have learned to cook.
- b. If Bill and Mary had never met, [JOHN]<sub>F</sub> would/might have been Mary’s roommate.

This environment gives rise to contrastive focus on [JOHN]<sub>F</sub>, a counterfactually supposed alternative to what is known in the actual world, namely that *Bill* is Mary’s roommate. In principle, there is no reason a consequent clause cannot contain a contrastively focused element when the consequent clause contrasts with a proposition that is known to be true in the actual world<sup>3</sup>. This is shown in (1b), where the consequent clause expresses the very same proposition

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<sup>1</sup> I will ignore the well known Anderson-counterfactuals with true antecedents like (i). Anderson’s (1951) examples seem to involve a kind a backwards reasoning that is not observed in ‘normal’ counterfactuals.

(i) If Jones had taken arsenic, he would have shown just exactly those symptoms which he does in fact show.

<sup>2</sup> I will assume that Mary only has one roommate. This assumption is necessary to facilitate the contrastive focus on ‘[JOHN]<sub>F</sub>’.

<sup>3</sup> For phonological reasons, it is somewhat awkward to pronounce the focused constituent in the consequent clause. That inversion of the (b) sentences produces the same results is shown in (i)-(iv):

- i. # [JOHN]<sub>F</sub> would/might have been Mary’s biological father if Sarah and Bill had never met.
- ii. [JOHN]<sub>F</sub> would/might have been Mary’s roommate if Sarah and Bill had never met.

as the antecedent clause in (1a). Given the felicity of (1b), the infelicity of (2b) is surprising as the two sentences are nearly identical.

(2) Bill and Sarah are Mary's biological parents.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>'s biological father, she<sub>1</sub> would/might have had better genes.
- b. #If Bill and Sarah had never met, [JOHN]<sub>F</sub> would/might have been Mary's biological father.

There is a similar contrast between (3b) and (4b), in which the location, but not the time, of Mary's birth can vary across possible worlds.

(3) Mary was born in Greece.

- a. If Mary<sub>1</sub> had been born in [FRANCE]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.
- b. If Sarah had been traveling, Mary would/might have been born in [FRANCE]<sub>F</sub>.

(4) Mary was born in 1991.

- a. If Mary<sub>1</sub> had been born in [1993]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.
- b. #If Sarah had waited to have a child, Mary would/might have been born in [1993]<sub>F</sub>.

Following Rooth (1985, 1996), it is argued that the contrastively focused elements in (1)-(2) give rise to an existential presupposition that there is a salient alternative to John in the context. By adopting Heim's (1992, 2002) definition of presuppositions as restrictions on a local context of evaluation, it is shown that if names are rigid designators—i.e. they rigidly refer to the *same* individual in every possible world—the contrast in acceptability between (1b) and (2b) follows from a shift in the local context of evaluation from the antecedent to the consequent

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- iii. #Mary would/might have been born in [1993]<sub>F</sub> if Sarah had waited to have a child.
  - iv. Mary would/might have been born in [FRANCE]<sub>F</sub> if Sarah had been traveling.

clause of a counterfactual conditional. Namely, the antecedent has access to both the actual context and the set of all possible worlds, whereas the consequent only has access to the set of worlds characterized by the antecedent. From this it follows that rigid designators in the consequent clause will trigger the infelicity of a counterfactual when they fail to have a referent in the worlds selected by the antecedent. In contrast, the antecedent clause is evaluated against the actual world, in which its rigid designators always have a referent.

In Section 1, Kratzer's (1981) truth conditions for counterfactual conditionals are explicated, including her proposal that certain facts lump together in counterfactual reasoning. Section 2 introduces Rooth's (1985, 1996) Alternative Semantics for contrastive focus. Following Rooth (1985, 1996) it is shown that contrastively focused constituents in counterfactual conditionals introduce existential presuppositions. Section 3 provides Heim's (1992, 2002) definition of presuppositions as requirements that are placed on the context. Here Heim's (1992, 2002) proposal that counterfactual conditionals can carry presuppositions is introduced in order to account for the existential presuppositions introduced by contrastively focused constituents. Heim's (1992, 2002) insight that counterfactual antecedents are evaluated against a broader context than their consequent clauses is then adopted into a Kratzer-style framework in order to account for the contrast between (1b) and (2b). However, these felicity conditions over-generate felicitous reading, making the wrong prediction about (2b).

In Section 4, it is proposed that by treating proper names as rigid designators that are sensitive to essential facts about their referents, we can capture the infelicity of (2b) by restricting the ability of proper names in consequent clauses to make reference. Section 5 demonstrates that the felicity conditions adopted from Heim's (1992, 2002) CCP semantics make the correct predictions about all eight of our target sentences in (1)-(4) only if we assume names

are rigid designators that are sensitive to essential properties of their referents. Finally, in Section 6 it is argued that Kratzer's (1981) counterfactual truth conditions make the right predictions about the 'biologically impossible' antecedents in (2a) and (4a) if treat names as rigid designators.

### 1. Kratzer (1981)

Our goal is ultimately to provide truth conditions for the target sentences above. Given the well known difficulties associated with the Lewis-Stalnaker similarity relation among possible worlds, we will adopt the truth conditions for counterfactuals proposed in Kratzer (1981). Let  $p$  represent the proposition expressed by a sentence with the form in (3),  $q$  represent the antecedent proposition ( $\alpha$ ) and  $r$  represent the consequent ( $\beta$ ).

(5) If it were the case that  $\alpha$ , then it would be the case that  $\beta$ ,

(Kratzer 1981, p. 201)

Let  $f$  be a function from the set of all possible worlds  $W$  that uniquely characterizes a world  $w$ , by assigning to each world the set of all of its true propositions. Since we are assuming a model in which a proposition is just a set of possible worlds  $w$ ,  $p$  is the set of all  $w \in W$  such that:

(1) If  $A_w(q)$  is the set of all consistent subsets of  $f(w) \cup \{q\}$  that contain  $q$ , then  $r$  follows

from every maximal set in  $A_w(q)$

(Kratzer 1981, p. 202)

Informally, Kratzer's (1981) truth conditions say that we take  $f(w)$ , the set of true propositions in the actual world, and combine it with the proposition expressed by the antecedent,  $q$ . Since it is known that  $q$  is false in the actual world, we need to eliminate any propositions in  $f(w) \cup \{q\}$  that are inconsistent with  $q$ ; this makes sure that each element of our resulting set  $A_w(q)$  is consistent. Then we check to see whether the consequent,  $r$ , follows from every maximal set in  $A_w(q)$ .

We can extend Kratzer's (1981) proposal above for *would*-counterfactuals to cover *might*-counterfactuals as well.

(6) If it were the case that  $\alpha$ , then it might be the case that  $\beta$ ,

where  $q$  and  $r$  represent the antecedent and consequent, respectively, let  $p$  be the set of all  $w \in W$  such that:

(7) If  $A_w(q)$  is the set of all consistent subsets of  $f(w) \cup \{q\}$  that contain  $q$ , then  $r$  follows from at least one maximal set in  $A_w(q)$ .

*Might*-counterfactuals have the same truth conditions as their *would* counterparts except that the former are true just in case there is *at least one* way of consistently adding propositions to a subset of  $A_w(q)$  such that the consequent,  $r$ , follows from this maximal set.

## 1.2 Why we need lumping

Kratzer (1981) warns that these truth conditions, as such, are inadequate. She provides the following example.

Hans and Babette spend the evening together. They go to a restaurant called "Dutchman's Delight," sit down, order, eat, and talk. Suppose now, counterfactually, that Babette had gone to a bistro called "Frenchman's Horror" instead. Where would Hans have gone? (I have to add that Hans rather likes this bistro). (1981, p. 206)

Kratzer (1981) observes that our intuitions are relatively sharp in this case: Hans would have gone to Frenchman's Horror with Babette. But this does not follow straightforwardly from the truth conditions given above. Here is why: Kratzer's (1981) truth conditions require that the consequent follow from every maximal set in  $A_w(q)$ . One way of building such a maximal set for this example is to remove the fact *Hans and Babette spend the evening together* from a consistent subset of  $f(w) \cup \{q\}$  that contains  $q$ . This subset still contains the fact *Hans went to Dutchman's Delight* as well as the antecedent *Babette went to Frenchman's Horror*. As there is

no contradiction here, we are free to turn our subset of  $f(w) \cup \{q\}$  into a maximal set in  $A_w(q)$  by adding additional premises. The problem is that if the set we just built is in  $A_w(q)$ , then not all consistent maximal sets in  $A_w(q)$  entail the consequent *Hans went to Frenchman's Horror*. This conflicts with our intuitions about the example.

Kratzer (1981) shows that we need lumping in order to solve this problem. She proposes that *Babette went to Dutchman's Delight* lumps the fact *Hans went to Dutchman's Delight*. Let  $p$  and  $q$  represent these two facts, respectively. Kratzer's (1981) claim is that rather than treating  $p$  and  $q$  as two true independent atomic facts in  $f(w)$ , the partition function lumps  $p$  and  $q$  into a single atomic fact,  $p \cap q$ . This lumped fact,  $p \cap q$ , is inconsistent with either  $\neg p$  or  $\neg q$ . That is, it takes only one of these two disjuncts to remove  $p \cap q$  from a consistent set. So, Kratzer's (1981) solution to the problem created by the restaurant example is that ' $p$  lumps  $q$ '.

To see the effect of this change, let  $r$  represent *Babette went to Frenchman's Horror*. If we counterfactually assume  $r$ , we have to remove  $p$  from  $A_w(r)$ . But  $p \cap q$  is an atomic fact in  $f(w)$ . So by removing  $p$  we automatically remove  $q$  as well. Now there are no propositions in  $A_w(r)$  inconsistent with *Hans and Babette spend the evening together*, so this fact remains.  $A_w(r)$  therefore contains both *Hans and Babette spend the evening together* and *Babette went to Frenchman's Horror*, from which it follows that Hans went to Frenchman's Horror too. In this way, lumping correctly accounts for our intuitions that *Hans went to Frenchman's Horror* follows from the counterfactual assumption *Babette went to Frenchman's Horror*.

### 1.3 The 'priorities' alternative

Kratzer (1981) offers lumping as an alternative to Pollack's (1976) insight that certain kinds of facts, like the laws of nature, seem to have priority over other, simpler facts when we consider counterfactual claims. Kratzer (1981) provides the following example:

Suppose, for instance, that there is a mirror next door. At the moment, I am not looking into it. But suppose I did. Would I see my face reflected or wouldn't I? I am sure I would. The laws of optics wouldn't change... What has to give way is the fact that I don't see my face reflected right now. Why is it that fact that has to be given up? We may seek an answer in terms of priorities. But we might just as well seek an answer in terms of lumping. (1981, p. 210)

Kratzer (1981) shows how “a-Pollock-like analysis” using ‘priorities’ might be incorporated into her truth conditions for counterfactuals (p. 205). Recall that we defined  $f(w)$  as the partition function from  $W$  that assigns to every world  $w$  the set of true propositions in  $w$ . Pollock’s insight is that there is more than one *kind* of true fact. For example, the laws of optics<sup>4</sup> are a different sort of fact than simple true propositions like *that I don't see my face reflected right now*. On this analysis, each kind of fact is assigned to  $w$  by its own partition function. Kratzer (1981) offers the following notation: Let  $f_1$  be the function from  $W$  that assigns to  $w$  all of the laws of nature true in  $w$  and let  $f_2$  be the function from  $W$  that assigns to  $w$  all of the true simple propositions in  $w$ . In a counterfactual conditional with the form ‘If it were the case that  $\alpha$ , then it would be the case that  $\beta$ ’, let  $p$  represent the antecedent and  $q$  the consequent. We can give  $f_1$  priority over  $f_2$  by ordering the construction of the superset,  $A_w(p)$ , in the following way: first, build  $A_w^1(p)$  = the set of all consistent subsets of  $f_1(w) \cup \{p\}$  that contain  $p$ ; next, build  $A_w^2(p)$  = the set of all consistent subsets of  $f_1(w) \cup f_2(w) \cup \{p\}$  that contain  $p$ . In this manner we could, in principle, continue on, so long as we specified an ordering (e.g.,  $f_1 < f_2 < f_3 \dots$ ) of the partition functions,  $f_n$ , each representing a different *kind* of true fact. This ordering on the application of partition functions represents a hierarchy of priorities among the different *kinds* of true facts.

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<sup>4</sup> This characterization of Pollock’s (1976) proposal is based on Kratzer’s (1981) adaptation. According to Kratzer (1981), Pollock’s (1976) actual term for the laws of nature is “strong subjunctive generalizations”. (Kratzer 1981, p. 204).

To see how the priorities approach generates the correct truth conditions for Kratzer's (1981) mirror example above, let  $f_1$  assign all of the natural laws, like the laws of optics, that are in force in  $w$  to  $w$  and  $f_2$  assign all of the true simple facts, such as *that I don't see my face reflected right now*, in  $w$  to  $w$ . Let our counterfactual antecedent,  $p$ , be *I am looking into the mirror right now*. Since natural laws have priority over simple true facts, we order the application of  $f_1 < f_2$  when constructing the maximal sets in  $A_w(p)$ . To do this, we first construct  $A_w^1(p)$  = the set of all consistent subsets of  $f_1(w) \cup \{p\}$  that contain  $p$ . This includes both the laws of optics in  $w$  and the antecedent, *I am looking into the mirror right now*. These two propositions entail *I see my face reflected right now*. Next we build  $A_w^2(p)$  = the set of all consistent subsets of  $f_1(w) \cup f_2(w) \cup \{p\}$  that contain  $p$ . Now  $f_2$  assigns the simple true facts in  $w$  to  $w$ , which include the fact that *I don't see my face reflected right now*. However, this fact must be excluded from  $A_w^2(p)$  because it is inconsistent with two facts in  $A_w^1(p)$ —namely the laws of optics in  $w$  and *that I am looking into the mirror right now*, which entail the fact *that I see my face reflected right now*. By giving the laws of optics priority over the simple fact *I don't see my face reflected right now*, we guarantee that the laws of optics remain in  $A_w(p)$  and any simple facts in  $f_2(w)$  that are inconsistent with the natural laws are thereby excluded.

The 'priorities' approach also accounts for Kratzer's (1981) restaurant example. Recall that in the restaurant example the intuition we want to account for is *Hans and Babette spend the evening together* takes precedence over *Hans went to Dutchman's Delight*. That is, when we assert counterfactually *Babette went to Frenchman's Horror*, we are willing to conclude that Hans went to Frenchman's Horror too but not that Hans went to Dutchman's Delight alone (or without Babette). In order to account for this intuition using the 'priorities' approach Kratzer (1981) observes that we might count *Hans and Babette spend the evening together* as a 'general

fact' in  $w^5$ . If general facts are given priority over simple true facts in  $w$ , such as *Hans went to Dutchman's Delight*, then the 'priorities' approach explains why *Hans went to Dutchman's Delight* is excluded from  $A_w(q)$ : general facts in  $w$  are added to  $f(w)$  before simple facts.

The 'priorities' approach makes the right predictions about Kratzer's (1981) mirror and restaurant examples; however, it fails to account for our intuitions about Kratzer's (1981) Bush walk example:

Regina and I go on a walk in the bush. We have to pass a hanging bridge. I pass first.  
Regina is waiting. I am in the middle of the bridge. Suppose now, counterfactually, that I had passed a bit faster and had just left the bridge. Where would Regina be? Would she still be waiting? (1981, p. 206)

Kratzer (1981) reports that *Regina might be passing* intuitively follows from the counterfactual supposition *I am not passing the bridge anymore*. Notice that this conclusion is weak in the sense that it contains the modal 'might'. Kratzer (1981) observes that the corresponding strong claim, involving 'would', does not intuitively follow as it is at least possible that *Regina might still be waiting*. It will be instructive to look first at how this latter consequence is attained.

It is easy enough to account for the intuition that *Regina might still be waiting*. Let  $p$  and  $q$  represent the facts *Regina is waiting* and *I am passing the bridge*, respectively. Now suppose, counterfactually, that I have already passed the bridge—so it is no longer the case that *I am passing the bridge* ( $\neg q$ ). This counterfactual supposition has the effect of removing  $q$  from  $A_w(\neg q)$  as neither  $q$  nor  $\neg q$  entail  $p$  or its negation. Consistency does not force  $p$  out of  $A_w(\neg q)$ , so  $p$  remains. But there is a problem. We have just built the truth conditions for the strong claim

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<sup>5</sup> Barbara Citko has pointed out to me that 'general facts' are not natural laws. However, the 'priorities' approach in principle allows for a plethora of *kinds* of facts that are ordered in terms of priority. We might assume that natural laws and true simple facts bookend this ordering as the minimal and maximal elements of the set of partition functions  $f_n$ .

*Regina would still be waiting* instead of the weaker claim *Regina might be waiting*. That is, if  $p$  remains in  $A_w(\neg q)$ , then  $p$  follows from  $A_w(\neg q)$ . Kratzer (1981) observes that this is the only option available to the ‘priorities’ approach. The problem is that giving priority to  $p$  over  $q$ , or vice versa, will not change the outcome: anyway you prioritize the facts,  $p$  remains in  $A_w(\neg q)$ . So the ‘priorities’ approach will always make wrong prediction about this case. That is, it predicts that only a *would* conditional is appropriate where our intuitions side with the weaker claim containing *might*. For the very same reason the ‘priorities’ approach is unable to account for our intuition that *Regina might be passing*. This conclusion simply cannot follow if  $A_w(\neg q)$  contains  $p$ , *Regina is waiting*.

Kratzer (1981) shows that we need lumping to account for our intuitions about this example. If  $p$  and  $q$  are actually two parts of the same fact—i.e. if  $p$  lumps  $q$ —then the counterfactual supposition that I am no longer on the bridge kicks out the single (lumped) fact  $p \cap q$ . Now adding the fact *Regina is passing* to a maximal set in  $A_w(\neg p)$  will not result in a contradiction. There is therefore *at least one way* of building a maximal set in  $A_w(\neg p)$  that includes the fact *Regina is passing*. But *Regina is passing* is not an element of *every* maximal set in  $A_w(\neg p)$ . Therefore, lumping predicts that we are only able to conclude *Regina might be passing*, not that she *would be*. The lumping relation makes the correct predictions regarding our intuitions about this case; so, we need lumping anyway.

#### **1.4 Natural laws**

Kratzer (1981) reasons that because the priorities approach cannot achieve the lumping effect by other means, we need lumping whether or not we adopt the ‘priorities’ approach. If lumping can account for the privileged status of certain facts, like the natural laws, then we can dispense of the ‘priorities’ approach after all.

To this end, Kratzer (1981) shows how the lumping relation is able to account for her mirror example above: Let  $p$  and  $q$  represent the propositions *I am looking into the mirror right now* and *I see my face reflected right now*. Both  $\neg p$  and  $\neg q$  are the case in the actual world. Kratzer (1981) suggests  $\neg p \cap \neg q$  form a single fact; that is,  $\neg p$  lumps  $\neg q$ . When we counterfactually suppose  $p$ , the single fact  $\neg p \cap \neg q$ , is forced out of  $A_w(p)$ . Because  $\neg p \cap \neg q$  is no longer in  $A_w(p)$  we can add  $q$  to at least *some* sets in  $A_w(p)$  without creating any inconsistencies. However, like the *Bush walk* example above, simply ‘leaving room’ to add a fact—here  $q$ —does not explain our intuition that what follows is the strong claim *I would see my face reflected right now*, not the weaker *I might see my face reflected right now*.

To show that  $q$  is an element of *every* maximal consistent set in  $A_w(p)$  we will have to expand on Kratzer’s (1981) suggestion that  $\neg p$  lumps  $\neg q$ . Our goal here is to elaborate on Kratzer’s (1981) proposal in order to explain the privileged status of the laws of nature using lumping. Let  $o$  represent the laws of optics. In  $f(w)$ ,  $o$  is responsible for the fact that  $\neg p$  lumps  $\neg q$ . However,  $o$  neither lumps  $\neg p \cap \neg q$  nor is lumped by it. We know this because if  $o$  were lumped with  $\neg p \cap \neg q$ , then  $o$  would be removed from  $A_w(p)$  along with  $\neg p \cap \neg q$ . But  $q$  is in every maximal consistent set of  $A_w(p)$ , so  $p$  and  $q$  must also be lumped by virtue of  $o$  (or at the very least be entailed by it). Since  $p$  and  $o$  are not lumped, the only way that  $o$  can be in every maximal set in  $A_w(p)$  is for  $o$  to already be in  $A_w(p)$ . If this is the case, then the presence of both  $p$  and  $o$  in  $A_w(p)$  entails that  $q$  will be in every maximal set in  $A_w(p)$ . This correctly predicts that the strong claim ‘I would see my face reflected right now’ follows from counterfactual antecedent ‘if I were looking into the mirror right now’.

What we know, then, is that  $o$  remains, or persists, in  $A_w(p)$ . But how can we explain this? At this point it is worth pointing out another shortcoming of the ‘priorities’ approach. Recall that

the ‘priorities’ approach gives preference to the natural laws by ‘allowing’ them to combine with the antecedent (and check for consistency) before the simple facts in  $f_2(w)$  are added. This ordering ensures facts in  $f_2(w)$  that are inconsistent with the antecedent do not make it into any consistent subset of  $f_2(w) \cup f_1(w) \cup \{q\}$ . However, this ordering seems to make the wrong predictions about examples like (8).

(8) If I were looking into the mirror but did not see my face reflected...

- a. the laws of optics might be different
- b. the lights might be off
- c. my mirror might be broken
- d. I might be going blind

The ordering that is crucial to the ‘priorities’ approach requires that we first build consistent subsets of the set  $f_1(w) \cup \{q\}$ . But  $f_1(w)$  contains  $o$  and  $o$  is inconsistent with the antecedent,  $q$ . So according to the ‘priorities’ approach, only the consequent in (8a) should follow from  $q$ . However, we are inclined to accept (8b-d) too. In fact, (8b-d) are much more intuitively plausible than (8a). That is, we have a strong preference to assume *our* natural laws (in  $w_0$ ) remain in force even in counterfactual scenarios. The ‘priorities’ approach is unable to explain this observation if we include the simple facts in (8b-d) in  $f_2(w)$ . Since these simple facts are not yet included when we compute  $f_1(w) \cup \{q\}$ , they cannot prevent inconsistency from arising between  $o$  and  $q$ . Therefore, the priorities approach incorrectly predicts that none of the consequents in (8b-d) intuitively follow.

To account for our intuitions about (8b-d) we might follow Kratzer (1981) in assuming that there is only one partition function,  $f$ . If this is the case, then the consistency of the subsets of  $f(w) \cup \{q\}$  is only evaluated once and simple facts like those in (8b-d) are able to prevent

inconsistency from arising between  $o$  and  $q$ . Kratzer's (1981) single partition function,  $f$ , is therefore necessary to account for our intuitions regarding (8), that we have a strong preference to keep the natural laws of the actual world in our counterfactual worlds.

Veltman (2005) makes a similar observation. He provides the following example. John's iron boat has sunk because John forgot to bail water out of it during a recent rain storm.

(9) If John's boat had been made of wood, it would not have sunk. (Veltman 2005, 166)

(10) If John's boat had been made of wood, it would (still) have sunk (Veltman 2005, 166)

Veltman (2005) observes, "we will stick to a law of nature like *Wood floats on water*, at the cost of a contingent fact like *John's boat sank*." (p. 166). In the above scenario it is certainly possible to conclude (10) but Veltman's (2005) observation is that we are more inclined to conclude (9) because we have a strong preference to assume our natural laws even in counterfactual situations.

We might summarize our observation in the following way: the natural laws of the actual world are *always* assumed to hold in counterfactual situations unless these laws are *forced* out of the maximal sets in  $A_w(q)$  by contradiction. While this descriptive generalization is sufficient for our purposes, we might speculate that the reason our natural laws persist into counterfactual situations is that it keeps these situations 'conceivable'. In the same vein, Kratzer (1989) writes "it seems plausible to assume that only humanly graspable propositions matter for the truth of a counterfactual." (p. 627). Since our intuitions about counterfactual situations grow weaker as we posit increasingly fundamental changes to the actual world (e.g. 8a), we might conclude that the counterfactual worlds we *want* to talk about are the ones that share our natural laws because these are the worlds about which our intuitions are relatively sharp.

Although speculative, this conclusion will go a long way in accounting for what we might call ‘physically impossible’ counterfactuals like (8a). Above we said that *I am not looking into the mirror right now* lumps *I do not see my face reflected right now* ( $\neg p \wedge \neg q$ ) and conversely *I am looking into the mirror right now* (or at least entails) *I do see my face reflected right now* ( $p \wedge q$ ). These facts were lumped by virtue of  $o$ . However, the antecedent in (8) counterfactually supposes both  $p$  and  $\neg q$  are the case. So no sets in  $A_w(p \wedge \neg q)$  contain  $p \wedge q$  or  $\neg p \wedge \neg q$  because both of these lumped facts are inconsistent with the antecedent. Moreover, the antecedent is inconsistent with  $o$  unless more facts are added to restore consistency (e.g. (8b-d)). In some maximal set of  $A_w(p \wedge \neg q)$  in which no such facts are added—namely (8a)— $o$  is eliminated by the antecedent.

While (8a) is somewhat marginal, it will be shown in section 4 that (2) and (4) (repeated here as (11) and (12), respectively) are also ‘physically impossible’ counterfactuals, as Mary could not have had different biological parents nor could she have been born at a different time given the biological laws in the actual world.

(11) Bill and Sarah are Mary’s biological parents.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>’s biological father, she<sub>1</sub> would/might have had better genes.
- b. #If Bill and Sarah had never met, [JOHN]<sub>F</sub> would/might have been Mary’s biological father.

(12) Mary was born in 1991.

- a. If Mary<sub>1</sub> had been born in [1993]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.
- b. #If Sarah had waited to have a child, Mary would/might have been born in [1993]<sub>F</sub>.

However, in order to analyze (11) and (12) we need a theory of focus. This is provided in the next section, where we adopt Rooth's (1985, 1996) Alternative Semantics to account for the semantic contribution of the contrastively focused elements in our target sentences.

Before turning to Section 2, let us briefly summarize what we have done so far. After showing that lumping provides more accurate predictions than the 'priorities' approach, we made the descriptive observation that the natural laws of the actual world often persist into counterfactual scenarios. We speculated that this phenomenon may be caused by cognitive limitations which prevent us from having strong intuitions about worlds too different from our own. We further observed that there are counterfactual scenarios that do not share our natural laws. We then showed how Kratzer's (1981) truth conditions, including lumping, are able to account for such 'physically impossible' counterfactuals.

## **2. Focus effects**

We need a theory of contrastive focus to explain the semantic contribution of the focused elements in (1)-(4). To this end we will adopt Rooth's (1985, 1996) Alternative Semantics for association with focus. In this section we will see that contrastive focus in counterfactuals gives rise to an existential presupposition.

The counterfactuals in (1)-(4) all contain phrases with contrastive focus. In his dissertation, Rooth (1985) provides an alternative-semantics for what he calls association with focus effects in counterfactual conditionals using Kratzer-style truth conditions.

Rooth introduces a modified example from Dretske (1972):

Clyde, a bachelor, has a relationship with Bertha, a busy academic and confirmed bachelor(ette). They see each other once a week, unless she has to work on a grant proposal or attend an interdisciplinary seminar. He learns that he stands to inherit a great deal of money at the age of thirty if he is married. Clyde finds [the] relationship he has with Bertha congenial, and would hate to abandon it for a marriage of the conventional

sort. Fortunately Bertha agrees to go through the legal formalities of marriage, it being understood that their relationship will continue exactly as before. (p. 213)

Rooth (1985) presents two examples from Dretske (1972) that differ only in their focused constituent.

(13) If Clyde hadn't MARRIED Bertha, he would not have been eligible for the inheritance.

(Rooth 1985, p. 214)

(14) If Clyde hadn't married BERTHA, he would not have been eligible for the inheritance.

(Rooth 1985, p. 214)

Rooth (1985) reports that, given Dretske's scenario above, (13) is true but (14) is false. This divergence in truth values is a direct result of a change in focus. Let us look at how Rooth's Alternative Semantics account for these intuitions. A phrase containing a focused element combines with a covert free variable  $C$  via the interpretation operator ' $\sim$ '. In (13), this step generates: [Clyde MARRIED Bertha]  $\sim C$ .<sup>6</sup> The free variable  $C$  denotes a contextually salient set of alternative propositions to the focused phrase. The interpretation operator  $\sim$  restricts  $C$  to only those alternative propositions in which the focused element has been replaced with a element of the same type. For the focused phrase in (14), this is the set of propositions with form [Clyde X-ed Bertha]. The interpretation operator  $\sim$  also introduces the presupposition that  $C$  contains at least two propositions: the proposition expressed by the focused phrase *without* focus —i.e. [Clyde married Bertha]—and at least one other proposition of the form [Clyde X-ed Bertha]. This is shown in (15).

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<sup>6</sup> Here we are taking for granted that the operator  $\sim$  takes narrow scope under the negation in (13).

(15) Where  $\phi$  is a syntactic phrase and  $C$  is a syntactically covert semantic variable,  $\phi \sim C$  introduces the presupposition that  $C$  is a subset of  $[[\phi]]^f$  containing  $[[\phi]]^o$  and at least one other element. (Rooth 1996, p. 279)

By (15) we know that for [Clyde MARRIED Bertha]  $\sim C$ ,  $C$  contains at least two propositions of the form [Clyde X-ed Bertha], one of which is [Clyde married Bertha].

The context provided by Dretske makes available at least two difference courses of action Clyde might have undertaken with respect to Bertha: Clyde might have married Bertha or he might have continued dating her, in which case they would not be married. The latter supplies  $C$  with its missing proposition, which has the form [Clyde continued dating Bertha]. So with respect to Dretske's scenario the focused phrase [Clyde MARRIED Bertha] introduces the presupposition that there were two available courses of action Clyde might have taken with respect to Bertha: he might have married her or he might have continued dating her. The former option is provided by the assertion of the focused phrase and the latter is supplied by the context.

The truth of (13) follows from the presuppositions of the focused phrase. Informally, (13) is true iff all of the worlds in which Clyde does not marry Bertha are worlds in which Clyde is not eligible for his inheritance and none of the worlds in which Clyde continues dating Bertha are worlds in which Clyde is eligible for his inheritance. That is, [Clyde married Bertha] must be the only element of  $C$  that would result in Clyde's being eligible for his inheritance. Since all worlds in which Clyde continues dating Bertha are worlds in which Clyde is not eligible for his inheritance, (13) is true.

The presuppositions of the focused phrase in (14) are calculated in parallel fashion. The focus phrase [Clyde married BERTHA] combines with  $\sim C$ , yielding [Clyde married BERTHA]

~ C. The interpretation operator restricts  $C$  to propositions of the form [Clyde married X] where  $C$  includes [Clyde married Bertha] and at least one other proposition of this form. Recall that when we calculated the presuppositions of the focused phrase in (13), the context supplied a second alternative proposition. Rooth (1985) proposes that this presupposed alternative is simply [Clyde married *someone*]. The focused phrase [Clyde married BERTHA] therefore carries the presupposition that there are at least two contextually salient individuals Clyde might have married: Bertha and *someone* else. The former option is supplied by the focused phrase whereas the latter option is supplied by the context.

We are now able to account for Rooth's (1985) intuition that (14) is false. Informally, (14) is true iff every world in which Clyde doesn't marry Bertha is one in which Clyde is not eligible for his inheritance and no worlds in which Clyde marries *someone else* are worlds in which Clyde is eligible for his inheritance. That is, [Clyde married Bertha] must be the only element in  $C$  that would result in Clyde's receiving his inheritance. Since a world in which Clyde married *someone else* is a world in which he receives his inheritance, (14) is false. The falsity of (14) therefore hinges on the existence of possible worlds in which Clyde marries someone other than Bertha. If no such worlds are contextually salient, then (14) merely expresses the obviously true proposition 'If Clyde hadn't married Bertha, he would not have been eligible for the inheritance.'

Rooth's (1985) association with focus therefore provides us with the following presuppositions for the focused phrases in our target sentences:

(16) [JOHN be Mary's biological father] ~  $C$ :

$$\sim C = \{w \in W \mid \text{John be Mary's biological father in } w\} \cup \{w \in W \mid \textit{someone other than John be Mary's biological father in } w\}$$

(17) [Mary be born IN 1993] ~ C:

$$\sim C = \{w \in W \mid \text{Mary be born in 1993}\} \cup \{w \in W \mid \text{Mary be born in a year other than 1993}\}.$$

(18) [JOHN be Mary's roommate] ~ C:

$$\sim C = \{w \in W \mid \text{John be Mary's roommate in } w\} \cup \{w \in W \mid \text{someone other than John be Mary's roommate in } w\}$$

(19) [Mary be born IN FRANCE] ~ C:

$$\sim C = \{w \in W \mid \text{Mary be born in France}\} \cup \{w \in W \mid \text{Mary be born in a country other than France}\}.$$

### 3. Context Change Potentials (CCP)

We have now established that the focused phrases in (16)-(19) carry existential presuppositions. Based on the work on Karttunen (1974), Heim's (1992, 2002) Context Change Potential (CCP) semantics offers an account of the presupposition projection properties of counterfactual conditionals. As both Karttunen (1974) and Heim (1992, 2002) observe, counterfactual conditionals inherit the presuppositions of their antecedents. In this section we will see how Heim's CCP semantics derives these presupposition projection properties for counterfactual conditionals.

#### 3.1 Heim's (1992, 2002) Context Change Potential Semantics

Heim's (1992, 2002) CCP semantics offers a presupposition sensitive alternative to traditional possible-world truth conditions. Her proposal is an extension of Karttunen's (1974) work on the presupposition projection properties of embedded clauses. In CCP semantics the meaning of a sentence is computed as a function from one context to another, rather than as a proposition (set of possible worlds). Contexts are defined as "states of information", which, like

propositions, are reducible to sets of possible worlds (Heim, 1992, p. 185). Heim constructs CCP semantics around the premise that sentences are not evaluated in a vacuum; they are uttered and interpreted against a backdrop of information—a context. In CCP semantics, a sentence has the effect of changing, or “updating” the context to which it is applied. The way in which a sentence updates its context is called its context change potential (CCP) (1992, p. 185).

In CCP semantics, presuppositions are requirements a proposition places on a context. A proposition is defined iff its context of utterance already contains or entails its presuppositions. Propositions are thus redefined as CCPs in which a clause’s traditional propositional content (i.e. a set of possible worlds) is evaluated with respect to a context. Heim observes that the requirements a proposition places on a context (i.e. its presuppositions) cannot be allayed; when a proposition is uttered or interpreted in a deficient context, the utterance will be undefined. Like traditional possible world semantics, the CCP of a matrix clause is computed compositionally from the CCPs of its constituent clauses.

### **3.2 Presupposition projection in conditionals**

Presupposition projection is the process by which the presuppositions of an embedded clause become the presuppositions of the entire sentence in which it is embedded.<sup>7</sup> For example, the simple sentences in (20) and (21) both presuppose that there is a king but only (21) presupposes that the king has a son.

(20) The king has a son. (Heim 2002, p. 249)

(21) The king’s son is bald. (Heim 2002, p. 249)

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<sup>7</sup> Karttunen (1974) and Heim (1992, 2002) also consider cases in which presuppositions project across sentential boundaries and from coordinated clauses but my construal of presupposition projection above will be sufficient for our purposes.

When the propositions above are combined to form the conditional in (22), we see that only the presuppositions of the antecedent ‘project’ to become the presuppositions of the whole sentence. That is, the conditional in (22) presupposes that there is a king but not that the king has a son (Heim 2002, p. 249).

(22) If the king has a son, the king’s son is bald. (Heim 2002, p. 249)

Heim (1992) provides a similar example. Imagine that Mary tells us she is calling from a phone booth, so it now part of the context that Mary is in the phone booth.

(23) If John is in the phone booth too, then the door doesn’t close.

(Adapted from Heim 1992, p. 196)

The presuppositions of the conditional in (23) are just the presuppositions of its antecedent, which presupposes that someone else is in the phone booth. Recall that, in CCP semantics, presuppositions are analyzed as requirements a proposition places on a context. For the proposition expressed by the antecedent in (23) to be defined, it must be evaluated in a context that contains (or entails) its presuppositions. ‘John is in the phone booth too’ presupposes that someone else is in the phone booth with John. The context provided by Heim (1992) already contains the information that Mary is in the phone booth. This context therefore satisfies the requirements of the antecedent clause. Since (23) as a whole presupposes that someone else is in the phone booth, (23) is felicitous in the context above.

Like (23), we saw that (22) is felicitous when uttered in a context that already contains (or entails) the presuppositions of its antecedent. But the consequent of (22) has its own presuppositions—that the king has a son. Heim (1992, 2002) observes that the presuppositions of the consequent are ‘cancelled’ if they are contained in the antecedent clause. In (22) the

antecedent clause's supposition that there is a king satisfies the presuppositions of the consequent clause. There is a similar cancelation effect in (24).

(24) If Mary is in the elevator, John is in the elevator too.

The conditional in (24) does not presuppose that someone else is in the elevator, as this information is supplied by the antecedent 'Mary is in the elevator'.

To account for this cancelation effect, Heim (1992) converts the Lewis/Stalnaker-style truth conditions for conditionals in (25) to the CCP for conditionals in (26). Let  $c$  represent the context and  $\phi$  and  $\psi$  represent the antecedent and consequent clauses, respectively.

(25)  $w \in \llbracket \text{if } \phi, \psi \rrbracket$  iff  $\text{Sim}_w(\llbracket \phi \rrbracket) \subseteq \llbracket \psi \rrbracket$ . (Heim 1992, p. 196)

(26)  $c + \text{if } \phi, \psi = \{w \in c : \text{Sim}_w(c + \phi) + \psi = \text{same}\}$ <sup>8</sup> (Heim 1992, p. 196)

The CCP in (26) states that a sentence of the form *if*  $\phi, \psi$  is defined iff the most 'similar' worlds in which  $c + \phi$  is defined are also worlds in which  $(c + \phi) + \psi$  is defined and there are no most 'similar' worlds in which  $c + \phi$  is defined but  $(c + \phi) + \psi$  is not. Notice that if a sentence is defined according to (26), it is true according to (25).

The CCP for conditionals in (26) accounts for both of our observations regarding presupposition projection in conditionals. Conditionals carry the presuppositions of their antecedents because a conditional is defined iff  $c + \phi$  is. The presuppositions of a consequent clause are canceled when the antecedent  $\phi$  already contains (or entails) them. This follows from (26) because  $\psi$ 's local context of evaluation,  $c + \phi$ , will contain (or entail)  $\psi$ 's presuppositions whenever  $\phi$  does. Under such circumstances  $c$  is not required to meet  $\psi$ 's presuppositions, so  $\psi$ 's presuppositions do not project.

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<sup>8</sup> ' $x + \psi = \text{same}$ ' is a shorthand for ' $x + \psi = x$ '.

Although Heim (1992, 2002) does not discuss it, one consequence of this result is that if  $\phi$  cannot meet the requirements of  $\psi$ , then  $c + \phi$  will only satisfy  $\psi$ 's presuppositions if  $c$  does. Under such circumstances,  $\psi$ 's presuppositions will project. This prediction is indeed borne out by (27a) and (27c).

- (27)
- a. If Dean told the truth, Nixon is guilty too. (Karttunen 1974, 182)
  - b. If Haldeman is guilty, Nixon is guilty too. (Karttunen 1974, 182)
  - c. If Miss Woods destroyed the missing tapes, Nixon is guilty too.

(Karttunen 1974, 182)

Karttunen (1974) reports (27a) presupposes that someone other than Nixon is guilty. Since  $\phi$  alone does not satisfy the presupposition that someone other than Nixon is guilty,  $c + \phi$  will only if  $c$  does. That is, if  $c$  already includes the information that there is *someone* else who is guilty, then  $\phi$  makes Dean contextually available to instantiate this existential quantifier. Under such circumstances  $c + \phi$  entails that Dean is guilty and  $(c + \phi) + \psi$  is defined. The consequent of (27a) thus projects the presupposition that there is *someone else* who is guilty and the antecedent supplies the rest. By contrast, (27b) contains a (now) familiar case of cancelation as the antecedent 'Haldeman is guilty' satisfies the presuppositions of the consequent. Karttunen indeed confirms that (27b) as a whole does not carry the presupposition that there is *someone else* who is guilty. Karttunen (1974) suggests that (27c) as a whole carries the presupposition that *someone else* is guilty only if Miss Wood's destruction of the tapes is not considered a crime.

### 3.3 CCP for Counterfactuals

Heim's (1992) central insight about counterfactuals is that, like their regular counterparts, counterfactual antecedents can carry presuppositions.

- (28) If John were in the phone booth too, then the door wouldn't close.

(Adapted from Heim 1992, p. 205)

Like other conditionals we have seen, the presuppositions of the counterfactual antecedent in (28) project. So it appears *prima facie* that (26) provides the correct CCP for counterfactuals as well. Recall Heim's example in which Mary says she is calling from a phone booth. Uttered in this context, (28) is defined as the context meets the requirements of  $\phi$ . Notice that (29) is also defined in this context.

(29) If John were in the phone booth, then the door wouldn't close.

(Adapted from Heim 1992, p. 205)

It is the contextually relevant fact that Mary is also in the phone booth that ensures the consequent follows from the antecedent in (29). However, Heim (1992) observes that (30) is also felicitous uttered in the same context.

(30) If John were in the phone booth, then Mary would be outside.

(Adapted from Heim 1992, p. 205)

The felicity of (30) uttered in a context in which it is known that Mary is inside the phone shows that counterfactual conditionals are not always evaluated in their actual context of utterance.

To account for examples like (28) and (29) in which *Mary is in the phone booth* remains in  $c$  and also cases like (30), where this fact seems to be ignored, Heim (1992) proposes that counterfactual conditionals are evaluated in a revised context,  $rev_{\phi}(c)$ . The revised context is the "least informative" superset of  $c$  that satisfies the presuppositions of the antecedent (Heim 1992, p. 204). A definition of  $rev_{\phi}(c)$  is given in (31).

(31) For any context  $c$ , LF  $\phi$ :

$rev_{\phi}(c)$ , the *revision of  $c$  for  $\phi$* , is  $\cup \{X \subseteq W: c \subseteq X \text{ and } X + \phi \text{ is defined}\}$ .

(Heim 1992, p. 204)

It follows from (31) that  $\text{rev}_\phi(c) + \phi$  is defined only if  $c + \phi$  is because  $\text{rev}_\phi(c)$  is a superset of  $c$ . Notice that this prevents  $\text{rev}_\phi(c)$  from accommodating any presuppositions of  $\phi$  that are not already present in  $c$ . This correctly predicts that counterfactuals uttered in contexts that do not already contain or entail their presuppositions will be infelicitous.

Adding (31) to the CCP for conditionals, Heim (1992) proposes the following CCP for counterfactual conditionals:

$$(32) \ c + \textit{if } \phi \textit{ would } \psi = \{w \in c : \text{Sim}_w(\text{rev}_\phi(c) + \phi) + \psi = \text{same}\}$$

(Heim 1992, p. 204)

The CCP in (32) states that a sentence of the form *if*  $\phi$  *would*  $\psi$  is defined iff the most ‘similar’ worlds in which  $\text{rev}_\phi(c) + \phi$  is defined are also worlds in which  $(\text{rev}_\phi(c) + \phi) + \psi$  is defined and there are no most ‘similar’ worlds in which  $\text{rev}_\phi(c) + \phi$  is defined but  $(\text{rev}_\phi(c) + \phi) + \psi$  is not.

Like their counterparts in (27), the counterfactual consequents in (33) place restrictions on their local context of evaluation,  $\text{rev}_\phi(c) + \phi$ .

- (33) a. If Dean had told the truth, Nixon would have been guilty too.

(Adapted from Karttunen 1974, 182)

- b. If Haldeman had been guilty, Nixon would have been guilty too.

(Adapted from Karttunen 1974, 182)

- c. If Miss Woods had destroyed the missing tapes, Nixon would have been guilty too.

(Adapted from Karttunen 1974, 182)

Although Heim (1992) does not address the presuppositions of counterfactual consequents, (33a), as a whole, takes the presuppositions of its consequent clause, namely that someone other

than Nixon is guilty. The presuppositions of the consequent in (33b) do not project as they are satisfied by the antecedent clause. Like (27c), (33c) presupposes that someone other than Nixon is guilty if Miss Woods' destruction of the tapes is not considered a crime. The examples in (33) therefore provide evidence that counterfactual consequents also place presuppositional requirements on their local context of evaluation.

### 3.4 A Kratzer-style CCP for counterfactuals

Heim (1992) anchors her CCP for counterfactuals to Lewis/Stalnaker-style truth conditions, which make use of the 'similarity' relation among possible worlds. We chose to adopt Kratzer's (1981) truth conditions in order to avoid including this problematic relation in our truth conditions. In this section we will provide a context sensitive version of Kratzer's (1981) truth conditions for counterfactual conditionals.

Rooth (1985) offers a means of incorporating the presuppositions of (14), repeated here as (34), into Kratzer's (1981) counterfactual truth conditions.

(34) If Clyde hadn't married BERTHA, he would not have been eligible for the inheritance.

(Rooth 1985, p. 214)

Rooth (1985) proposes that  $f(w)$  includes the proposition [Clyde marry *someone*] as  $f(w)$  is sensitive to the context. There are therefore consistent maximal sets of  $A_w(q)$  that include worlds in which Clyde does not marry Bertha but marries someone. In such worlds, Clyde is eligible for the inheritance.

Invoking Heim's (1992, 2002) more nuanced account of presuppositions as requirements that are placed on a context, we might implement Rooth's (1985) proposal in the following way. Let  $p$  represent the proposition expressed by a counterfactual conditional of the form *if  $\phi$  would  $\psi$* , where  $q$  and  $r$  represent the propositions expressed by  $\phi$  and  $\psi$ , respectively.

(35)  $p$  is the set of all  $w \in W$  such that:

If  $A_w(q)$  is the set of all consistent subsets of  $f(w) \cup \{q\}$  that contain  $q$ , then  $r$  follows from every maximal set in  $A_w(q)$ .

(36) *Felicity Conditions for (28)*:  $f(w) + p$  is defined iff (i) and (ii) are.

- i.  $f(w) + q$
- ii.  $A_w(q) + r$

Let us first verify that (36) provides the correct felicity conditions for (34). The focused constituent in the antecedent [Clyde married BERTHA]  $\sim C$  introduces two propositions into  $\sim C$ , [Clyde married Bertha] and [Clyde married *someone*], where *someone* cannot be instantiated by Bertha. So,  $\sim C$  is the set of worlds  $\{w \in W \mid \text{Clyde married Bertha in } w\} \cup \{w \in W \mid \text{Clyde married } \textit{someone else} \text{ in } w\}$ . The former alternative is given by the context. The step in (36i) is defined iff  $f(w)$  entails or already contains  $\{w \in W \mid \text{Clyde married } \textit{someone else} \text{ in } w\}$ . Kratzer (1989) observes that in Dretske's example,  $f(w)$  contains *Clyde married Bertha* but it also contains  $\neg \textit{Clyde married CATHERINE}$ ,  $\neg \textit{Clyde married OLGA}$ , etc. Removing *Clyde married Bertha* from  $f(w)$  would therefore entail that Clyde married no one. But the worlds in which Clyde married no one are not worlds in which Clyde is eligible for the inheritance. (27) would therefore come out as true, when our intuitions tell us that it is false.

To correctly account for our intuitions about (34) we need lumping. Kratzer (1989) proposes that *Clyde married Bertha* lumps all of the propositions of the form  $\neg \textit{Clyde married CATHERINE}$ ,  $\neg \textit{Clyde married OLGA}$ , etc. When *Clyde married Bertha* is removed from  $A_w(q)$  by  $q$  all of the propositions lumped by *Clyde married Bertha* are also removed. Now every way of building a maximal set in  $A_w(q)$  is consistent with *Clyde married CATHERINE* or *Clyde*

*married OLGA*, etc., that is, *Clyde married someone*. So by lumping *Clyde married Bertha* with  $\neg$ *Clyde married CATHERINE*,  $\neg$ *Clyde married OLGA*, etc.,  $f(w)$  entails that either *Clyde married Bertha* or *Clyde might have married someone else*. So  $f(w) + q$  is defined. Since the consequent  $r$ , places no requirements on its local context  $A_w(q)$ ,  $A_w(q) + r$  is also defined. With an appeal to lumping (36) correctly predicts that (34) is felicitous when uttered in the context provided by Dretske. We now turn to the truth conditions for (34).

We want to verify that (35) confirms Rooth's (1985) intuitions that (34) is false. Every maximal set in  $A_w(q)$  contains the set of worlds  $\{w \in W \mid \neg \text{Clyde married Bertha in } w\}$ . We said it was consistent with every maximal set in  $A_w(q)$  that Clyde married someone, thanks to lumping in  $f(w)$ . Therefore, there are at least some worlds in  $A_w(q)$  in which Clyde is eligible for the inheritance. So it is not true that  $r$  follows from every maximal set in  $A_w(q)$ . Therefore, (35) correctly predicts that (34) is false. So (35) and (36) make the right predictions about Dretske's example.

### 3.5 Deriving infelicity

Although (36) is able to account for the felicity of (1a-b), repeated here as (37a-b), it incorrectly predicts that (2b), repeated here as (38b), is also felicitous. First, we need to show that (36) predicts the felicity of (37a-b).

(37) Bill is Mary's roommate.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>'s roommate, she<sub>1</sub> would/might have learned to cook.
- b. If Bill and Mary had never met, [JOHN]<sub>F</sub> would/might have been Mary's roommate.

(38) Bill and Sarah are Mary's biological parents.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>'s biological father, she<sub>1</sub> would/might have had better genes.
- b. #If Bill and Sarah had never met, [JOHN]<sub>F</sub> would/might have been Mary's biological father.

The  $\sim$ C-set for the antecedent in (37a) is shown in (39).

$$(39) \sim C = \{w \in W \mid \text{John be Mary's roommate in } w\} \cup \{w \in W \mid \textit{someone else be Mary's roommate in } w\}$$

The context  $f(w)$  includes *Bill is Mary's roommate* and Mary only has one roommate. Much like Kratzer's (1981) restaurant example, this general fact lumps *Bill is Mary's roommate* with negative propositions of the form  $\neg$ *JOHN is Mary's roommate*,  $\neg$ *JANE is Mary's roommate*, etc.  $f(w)$  therefore entails that if Bill is Mary's roommate, John isn't and if John is Mary's roommate, Bill isn't. The antecedent's local context of evaluation ( $f(w)$ ) therefore meets the requirements imposed on it by (39); that is, either John is Mary's roommate, or Bill is. So  $f(w) + q$  is defined. The consequent in (37a) does not place any requirements on its local context, so  $A_w(q) + r$  is also defined. (36) therefore correctly predicts that (37a) is felicitous.

We can also account for the acceptability of (37b) using lumping. The antecedent in (37b) does not place any requirements on its local context of evaluation, so  $f(w) + q$  is defined. The  $\sim$ C-set for the consequent of (37b) is shown in (40).

$$(40) \sim C = \{w \in W \mid \text{John is Mary's roommate in } w\} \cup \{w \in W \mid \textit{someone other than John is Mary's roommate in } w\}$$

The context  $f(w)$  contains *Bill is Mary's roommate*, which lumps  $\neg$ *JOHN is Mary's roommate*,  $\neg$ *JANE is Mary's roommate*, etc. by virtue of the fact that Mary has only one roommate.

Although *Bill is Mary's roommate* was given, this fact has been removed from every maximal

set in  $A_w(q)$ , which, by definition, all contain the antecedent *Bill and Mary never met*. Since *Bill is Mary's roommate* lumps  $\neg$ *JOHN is Mary's roommate*,  $\neg$ *JANE is Mary's roommate*, etc. these negative propositions have also been removed from every maximal set in  $A_w(q)$ . We know that every maximal set in  $A_w(q)$  contains *Mary has only one roommate*, so John will be Mary's roommate in some maximal sets in  $A_w(q)$  and Jane in others. Therefore, the maximal sets in  $A_w(q)$  contain the presuppositions in (40); that is, it is true of every maximal set that either John is Mary's roommate or someone else is. So the consequent's local context of evaluation already contains the consequent's presuppositions and  $A_w(q) + r$  is defined. (37b) is thus correctly predicted to be felicitous.

With the help of lumping, the felicity conditions in (36) make the correct predictions about (37a-b). The problem is that these conditions, as such, over-generate felicitous readings. For example, consider the infelicitous (38b). The antecedent in (38b) places no presuppositions on its local context of evaluation, so  $f(w) + q$  is defined. The focused phrase in (38b) [*JOHN be Mary's biological father*]  $\sim$  C yields (41).

$$(41) \sim C = \{w \in W \mid \text{John be Mary's biological father in } w\} \cup \{w \in W \mid \textit{someone other than John be Mary's biological father in } w\}$$

Since (38b) is formally identical (37b), we might treat them in the same way. Assuming that *having met* is a precondition for *producing a child with*<sup>9</sup>, the fact that *Bill is Mary's biological father* is not in any maximal set in  $A_w(q)$  because it is inconsistent with the antecedent. As we did in (37b), we might assume that this fact lumps negative propositions of the form  $\neg$ *JOHN is Mary's father*,  $\neg$ *JACK is Mary's father*, etc. by virtue of the general fact that every individual has at least one biological father. Since these negative propositions are removed from every

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<sup>9</sup> This precludes situations involving anonymous donors.

maximal set in  $A_w(q)$  along with *Bill is Mary's biological father*, no inconsistency arises from adding *JOHN is Mary's biological father* to some maximal sets in  $A_w(q)$  and *JACK is Mary's biological father* to others. The general fact that everyone has exactly one biological father, guarantees that in every maximal in  $A_w(q)$  either John is Mary's biological father, or someone else is. The maximal sets in  $A_w(q)$  thus already contain the presuppositions of the consequent clause shown in (41) and  $A_w(q) + r$  is defined. So our felicity conditions incorrectly predict that (38b) is felicitous.

Looking back, once *Bill is Mary's biological father* was eliminated from every maximal set in  $A_w(q)$ , our assumption that everyone has exactly one biological father 'made room' in each maximal set for propositions of the form *JOHN is Mary's biological father*, *JACK is Mary's biological father*, etc. Kripke (1980) reports having the intuition that if names are rigid designators, a counterfactual world in which Mary's parents never met is a world in which Mary never existed at all. In the next section we will adopt Kripke's (1980) proposal that names are rigid designators and show how his essentialist intuitions explain the infelicity of (38b).

#### **4. Proper names as rigid designators**

Kripke (1980) famously refuted the Russell-Frege descriptive theory of proper names, according to which the meaning of a name is a singular definite description that uniquely identifies the name's bearer in the actual world. In place of the descriptive theory, Kripke (1980) proposed that proper names are *rigid designators*, which are defined as terms that denote the same object in every possible world in which that object exists (p. 48). The intuitive difference in truth values between (42a) and (42b) support this distinction between definite descriptions and *rigid designators*.

(42) a. Someone other than the U.S. President in 1970 might have been the U.S. President in 1970. (Kripke 1980, p. 48)

b. Someone other than Nixon might have been Nixon. (Kripke 1980, p. 48)

(42a) is true. Kripke (1980) suggests, for example, that Humphrey might have been the U.S. president in 1970 if the elections had gone differently. On the other hand, (42b) is intuitively false: there are no worlds in which someone other than Nixon might have been Nixon. The name ‘Nixon’ therefore rigidly designates the same individual across worlds while the definite description ‘the U.S. President in 1970’ does not.

To represent this formally, we can assume names are free pronouns that bear indices at LF (Heim & Kratzer 1998, p. 243). Indices are just world-time (ordered) pairs that are mapped to the individuals they denote by an assignment function  $g_c$  (Dowty, Wall & Peters 1981, p. 146, Heim & Kratzer 1998, p. 243). Assignment functions from indices to individuals ( $g_c$ ) are supplied by a context,  $c$ . (H&K 1998, p. 243). Dowty, Wall & Peters (1981) represent rigid designators as a constant function from indices to individuals (p. 146). For example, (43) provides the intension of  $\llbracket \text{Nixon} \rrbracket^{g_c}$ . Let the constant  $n$  represent the individual (type  $e$ ) that is Nixon.

(43)  $\llbracket \text{Nixon} \rrbracket^{g_c} =$

$\langle w_1, t_1 \rangle$	$\rightarrow n$
$\langle w_2, t_1 \rangle$	$\rightarrow n$
$\langle w_1, t_2 \rangle$	$\rightarrow n$
$\langle w_2, t_2 \rangle$	$\rightarrow n$
...	(Adapted from Dowty, Wall & Peters 1981, p. 146)

According to (43), ‘Nixon’ denotes  $n$  at every index at which it refers. Compare this to the intension of the definite description  $\llbracket \text{the U.S. President in 1970} \rrbracket^{g_c}$ , shown in (44).

$$\begin{aligned}
 (44) \llbracket \text{the U.S. President in 1970} \rrbracket^{\text{sc}} = & \quad \langle w_1, t_1 \rangle \rightarrow n \\
 & \quad \langle w_2, t_1 \rangle \rightarrow h \\
 & \quad \langle w_1, t_2 \rangle \rightarrow n \\
 & \quad \langle w_2, t_2 \rangle \rightarrow h \\
 & \quad \dots
 \end{aligned}$$

(Adapted from Dowty, Wall & Peters 1981, p. 146)

Unlike the denotation of ‘Nixon’, the denotation a definite description like ‘the U.S. president in 1970’ varies depending on the assignment function supplied by the context.

#### 4.2 Kripke’s (1980) intuitions regarding essential properties

Kripke (1980) observes that a counterfactually supposed significant change in an individual’s *essence* can prevent a rigid designator from making reference. Guided by Kripke’s (1980) intuitions we will adopt the position that a change in an individual’s *origin* can affect our intuitions about the existence of that individual in a counterfactual situation. To see how this works it is constructive to consider an example.

Imagine that we have doubts about Elizabeth II’s lineage. We might wonder, for example, ‘Could Elizabeth II have different parents than she reports to have?’ Kripke (1980) distinguishes this epistemic concern from the metaphysical one, “...could the Queen—could this woman herself—have been born of different parents from the parents from whom she actually came? Could she, let’s say, have been the daughter instead of Mr. and Mrs. Truman?” (p. 112). Notice that the metaphysical question is not ‘Could she *be* the daughter of Mr. and Mrs. Truman?’ but rather ‘Could she *have been*...?’. About *this individual*, Kripke (1980) goes to write:

...can we imagine a situation in which it would have happened that this very woman came out of Mr. and Mrs. Truman? They might have had a child resembling her in many

properties. Perhaps in some possible world Mr. and Mrs. Truman even had a child who actually became the Queen of England and was even passed off as the child of other parents. This still would not be a situation in which *this very woman* whom we call 'Elizabeth II' was the child of Mr. and Mrs. Truman...It would be a situation in which there was some other woman who had many of the properties that are in fact true of Elizabeth...How could a person originating from different parents, from a totally different sperm and egg, be *this very woman*? (Kripke 1980, p. 112-113)

Kripke (1980) captures his intuitions about this case (and others) with the following generalizations:

(45) If a material object has its origin from a certain hunk of matter, it could not have had its origin in any other matter. (Kripke 1980, p. 114)

From (45) it follows:

(46) The *origin* of an object is essential to it. (Kripke 1980, p. 114)

For our purposes, we might think of (45) and (46) as generalizations that *describe* our intuitions, rather than necessary and sufficient conditions for existence. Here is how (45) and (46) are relevant. Every human came from a particular sperm and egg. By (45) and (46) an individual, *x*, could not have come from a different sperm or egg than *x* actually came from. Therefore, *x* could not have had different biological parents than *x* did. Moreover, given the life cycle of these biological components, *x* could not have been conceived much earlier or much later than *x* was in fact conceived. Kripke's (1980) intuitions about biological origins follow from our biological and reproductive laws in the actual world. For this reason Kripke's (1980) intuitions as captured in (45) and (46) will only apply in worlds that share our biological laws. From this it follows that in counterfactual worlds that do not share our biological and reproductive laws, Kripke's (1980) intuitions about our biological origins crucially no longer apply.

If names are rigid designators, then they denote the same individual in every world in which that individual exists. That is, the name ‘X’ denotes the individual  $x$  in every world in which  $x$  exists. Kripke’s (1980) intuitions suggest that  $x$  does not exist in worlds with our biological laws in which its essence has been fundamentally altered. This includes worlds in which (i) it is supposed that  $x$  has different parents than  $x$  actually had or (ii) it is supposed that  $x$  was born at a significantly earlier or later time than  $x$  was in fact born.

We have just described intuitive conditions for the existence of an individual in a world. A rigid designator will fail to refer in a world in which we have an intuition that its referent does not exist. We can capture this intuition formally if we assume the felicity of an utterance containing a name is subject to the following condition:

(47) *Appropriateness Condition*

A context  $c$  is *appropriate* for an LF  $\phi$  only if  $c$  determines a variable assignment  $g_c$  whose domain includes every index which has a free occurrence in  $\phi$ .

(Heim & Kratzer 1998, p. 243)

An LF  $\phi$  will therefore be infelicitous whenever it includes a name with an index that is not in the domain of the assignment function  $g_c$ , which is provided by the context. Let  $N$  represent a name that rigidly refers to the individual  $n$  in every possible world in which  $N$  refers at all. If LF  $\phi$  contains  $N_2$  and is interpreted in context  $c_1$  but we have intuitions that  $n$  does not exist in  $c_1$ , then  $g_{c_1}$  will not assign  $N$ ’s index to a referent. Under such circumstances  $2$  is not in the domain of  $g_{c_1}$ , and LF  $\phi$  is undefined (=infelicitous). This nearly amounts to an existence presupposition on names as it places certain requirements on the context.<sup>10</sup>

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<sup>10</sup> I avoided reducing this claim to *just* an existence presupposition for two reasons. First, I have tried to be careful and describe *intuitions* about existence rather than necessary and sufficient

## 5. Deriving complete felicity conditions

In this section we will show that counterfactual changes in the circumstances of Mary's birth are what give rise to the infelicity of (2b) and (4b), repeated below as (48a) and (49a).

(48) Bill and Sarah are Mary's biological parents.

- a. #If Bill and Sarah had never met, [JOHN]<sub>F</sub> would/might have been Mary's biological father.

(49) Mary was born in 1991.

- a. #If Sarah had waited to have a child, Mary would/might have been born in [1993]<sub>F</sub>.

Given the Appropriateness Condition in (47), the antecedent of (48a) is defined iff  $f(w)$  provides an assignment function that maps Bill to  $b$  and Sarah to  $s$ . Since  $f(w)$  is the partition function for the actual world,  $f(w)$  contains the assignment function  $g_c$  that is enforced in the actual world. This assignment function maps Bill to  $b$  and S to  $s$ , so  $f(w) + q$  is defined.

We can assume that every maximal set in  $A_w(q)$  contains the biological/reproductive laws in force in the actual world as they are not forced out by contradiction with the antecedent. On the other hand, *Bill is Mary's biological father* is forced out of every maximal set in  $A_w(q)$  because it is inconsistent with the antecedent. So every maximal set in  $A_w(q)$  contains the biological/reproductive laws of the actual world but describes a situation in which *m's origins* are significantly altered. In section 4 we restricted Kripke's (1980) essentialist intuitions to counterfactual situations that share our biological laws. Since every maximal set in  $A_w(q)$  describes such a situation, Kripke's (1980) intuitions predict that Mary does not exist in the

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conditions for existence, as the latter are a matter of much philosophical debate. Second, well known examples like (i) are *prima facie* problematic for an existence presupposition.

- i. Santa Clause does not exist.

situations described by any of these maximal sets. Therefore, no maximal set in  $A_w(q)$  contains an assignment function that assigns an index on Mary to  $m$ . In other words, the proper name ‘Mary’ in the consequent clause does not have a referent in its local context of evaluation. This constitutes a violation of the Appropriateness Condition and (48a) is correctly predicted to be infelicitous as  $A_w(q) + r$  is undefined.

Furthermore, the definite description ‘Mary’s biological father’ in the consequent clause is undefined if ‘Mary’ is (c.f. ‘the king’s son’ is undefined if there is no king). So, the maximal sets in  $A_w(q)$  do not contain or entail alternative propositions of the form *someone* is Mary’s biological father, since the definite description ‘Mary’s biological father’ is undefined in this context. The infelicity of (48a) thus follows straightforwardly from Kripke’s (1980) proposal that names are rigid designators and his intuitions regarding essential properties.

We can similarly account for the infelicity of (49a), repeated here as (50a).

(50) Mary was born in 1991.

- a. #If Sarah had waited to have a child, Mary would/might have been born in [1993]<sub>F</sub>.

The assignment function that maps ‘Sarah’ to  $s$  in the actual world is in  $f(w)$ , so  $f(w) + q$  is defined. The antecedent in (50a) does not force the biological/reproductive laws out of the maximal sets in  $A_w(q)$ , so they remain in every maximal set. If Sarah had waited to have a child, then she would have waited to have Mary. So, no maximal set in  $A_w(q)$  describes a world in which Sarah had Mary in 1991. It follows that every maximal set in  $A_w(q)$  describes a situation in which  $m$ ’s *origins* are significantly altered but the biological/reproductive laws are not.

Following Kripke’s (1980) intuitions,  $m$  does not exist in any world characterized by a maximal set in  $A_w(q)$ . Therefore, the consequent’s local context of evaluation,  $A_w(q)$ , does not assign the

index on ‘Mary’ in its domain and the name fails to refer. By the Appropriateness Condition,  $A_w(q) + r$  is therefore undefined. So, (50a) and (48a) turn out to be infelicitous for the very same reason.

We have demonstrated that the felicity conditions in (36) correctly predict the infelicity of the ‘physically impossible’ counterfactuals in (48a) and (50a) when couched in a framework that treats proper names as rigid designators and implements Kripke’s (1980) essentialist intuitions. The reader can verify that the felicity conditions for (1a-b) and (3a-b) (repeated here as (51a-b) and (52a-b), respectively) will not be affected by our decision to treat proper names as rigid designators as these counterfactuals do not posit changes to an individual’s essential properties.

(51) Bill is Mary’s roommate.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>’s roommate, she<sub>1</sub> would/might have learned to cook.
- b. If Bill and Mary had never met, [JOHN]<sub>F</sub> would/might have been Mary’s roommate.

(52) Mary was born in Greece.

- a. If Mary<sub>1</sub> had been born in [FRANCE]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.
- b. If Sarah had been traveling, Mary would/might have been born in [FRANCE]<sub>F</sub>.

The felicity conditions for (51a-b) are provided in Section 3.5, where it is shown that lumping accounts for the felicity of (51a-b). The felicity of (52a-b) is derived in parallel fashion<sup>11</sup>.

The only examples we have not yet accounted for are the ‘physically impossible’ counterfactuals in (2a) and (4a) (repeated here as (53a) and (54a), respectively).

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<sup>11</sup> I will not provide a detailed analysis of the sentences in (52a-b). I have included this example to provide a contrast for the counterfactuals in (4a-b). The reader is referred to the nearly identical analysis of (51a-b) in Section 3.5.

(53) Bill and Sarah are Mary's biological parents.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>'s biological father, she<sub>1</sub> would/might have had better genes.

(54) Mary was born in 1991.

- a. If Mary<sub>1</sub> had been born in [1993]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.

In Section 1.4 we made the generalization that the natural laws of the actual world are assumed to persist into counterfactual situations unless these laws are *forced* out of the maximal sets in  $A_w(q)$  by contradiction. The antecedents in (53-54a) express biologically 'impossible' propositions. That is, if proper names are rigid designators, no worlds that share our biological/reproductive laws are worlds in which John is Mary's biological father; nor are they worlds in which Mary was born in 1993. However, Kratzer's (1981) truth conditions require that the maximal sets in  $A_w(q)$  describe worlds in which the antecedent is true, however unlikely these worlds may be. Since we are working within a framework that treats proper names as rigid designators,  $A_w(q)$  will be the empty set unless 'John' and 'Mary' are assigned to  $j$  and  $m$ , respectively. The local context of evaluation for  $q$  is the partition function  $f(w)$ , which includes the assignment function that assigns 'John' to  $j$  and 'Mary' to  $m$  in the actual world. As this assignment function is already in the antecedent's local context, it satisfies the Appropriateness Condition for the antecedents in (53-54a) by assigning 'John' to  $j$  and 'Mary' to  $m$ .

This analysis makes the prediction that if the antecedent of (50a), repeated here as (55a), contained the proper name 'Mary' in place of the indefinite 'a child', the counterfactual would be felicitous.

(55) Mary was born in 1991.

- a. #If Sarah had waited to have a child, Mary would/might have been born in [1993]<sub>F</sub>.
- b. If Sarah had waited to have Mary, Mary would/might have been born in [1993]<sub>F</sub>.

This is predicted as the assignment function from the actual world would persist into the updated context (every maximal set in  $A_w(q)$ ) after assigning the occurrence of ‘Mary’ in the antecedent to  $m$ . This prediction is indeed borne out as (55b) a marked improvement on (55a).

The presuppositions introduced by the focused constituent in (53a) are shown in (56).

(56) [JOHN be Mary’s biological father]  $\sim C$ :

$$\sim C = \{w \in W \mid \text{John be Mary’s biological father in } w\} \cup \{w \in W \mid \textit{someone other than John be Mary’s biological father in } w\}$$

The partition function  $f(w)$  includes *Bill is Mary’s biological father*, which is given.  $f(w)$  additionally contains the biological/reproductive laws of the actual world, as they are not removed until the antecedent combines with  $f(w)$  to create  $A_w(q)$ . The biological/reproductive laws in  $f(w)$  lump *Bill is Mary’s biological father* with  $\neg$ *JOHN is Mary’s biological father*,  $\neg$ *JACK is Mary’s biological father*, etc. The antecedent’s local context of evaluation,  $f(w)$ , therefore entails that either John is Mary’s biological father, or someone else is. The presuppositions introduced in (56) are thus entailed by  $f(w)$ . Because the Appropriateness Condition is also met,  $f(w) + q$  is defined. The consequent in (53a) does not carry any presuppositions, so  $A_w(q) + r$  is defined and (53a) is correctly predicted to be felicitous.

The focused element in (54a) similarly introduces the presuppositions shown in (57).

(57) [Mary be born IN 1993]  $\sim C$ :

$$\sim C = \{w \in W \mid \text{Mary be born in 1993}\} \cup \{w \in W \mid \text{Mary be born in a year other than 1993}\}.$$

Like (53a), the partition function in (54a)  $f(w)$  includes the given information *Mary was born in 1991*. Given the biological/reproductive laws in the actual world, which initially are in  $f(w)$ , *Mary was born in 1991* lumps propositions of the form  $\neg$ *Mary was born in 1992*,  $\neg$ *Mary was born in 1993*, etc. So  $f(w)$  entails that either Mary was born in 1993, or she was born in some other year. This satisfies the presuppositions shown in (57). Since the Appropriateness Conditions is also met,  $f(w) + q$  is defined. The consequent in (54a) does not place any restrictions on its local context, so  $A_w(q) + r$  is defined and (54a) is correctly predicted to be felicitous.

In this section we have shown that the felicity conditions for counterfactual conditionals provided in (36) make the correct predictions regarding the felicity of the counterfactuals in (1)-(4), our target sentences. By couching our felicity conditions in a framework that treats proper names as rigid designators and observing Kripke's (1980) essentialist intuitions, we were able to account for the infelicity of the (48a) and (50a) as well as the felicity of (53a) and (54a).

The contrast in acceptability between the felicitous 'physically impossible' antecedents in (53-54a) and the infelicitous 'physically impossible' consequents in (48a) and (50a) are result of the change in context of evaluation from the antecedent to the consequent as proposed by Heim (1992, 2002). Specifically, a counterfactual antecedent is evaluated with respect to its local context,  $f(w)$ , the partition function for the actual world. Counterfactual consequents, however, are evaluated against an updated context, the maximal sets in  $A_w(q)$ , which contain the elements of  $f(w)$  that are not inconsistent with the antecedent,  $q$ . The 'physically impossible' antecedents in (53-54a) are felicitous by virtue of the fact that they are evaluated against the natural laws and assignment function of the actual world, whereas the 'physically impossible' consequents in

(48a) and (50a) are evaluated with respect to the maximal sets in  $A_w(q)$ , which no longer maintain all of the natural laws or assignment functions from the actual context  $f(w)$ .

There is one last problem to address, however. While the ‘physically impossible’ antecedents in (53-54a) are felicitous, they *prima facie* express propositions that are not possible given Kripke’s (1980) essentialist intuitions and the biological/reproductive laws in the actual world. As we said above, there are no worlds that share our biological/reproductive laws in which John is Mary’s biological father *instead*. The worry is that while the felicity conditions in (36) makes the correct predictions, the truth conditions in (35) incorrectly predict that ‘physically impossible’ counterfactuals are vacuously true. In the next section, we will show that Kratzer’s (1981) truth conditions couched in a framework that treats names as rigid designators and heeds Kripke’s (1980) essential intuitions provides adequate truth conditions for the ‘physically impossible’ counterfactuals in (48a), (50a) and (53-54a).

## **6. Truth conditions for ‘physically impossible’ counterfactuals**

This thesis is an investigation of the felicity conditions for counterfactuals containing proper names. However, the felicity conditions in (36) crucially depend on Kratzer’s (1981) truth conditions to make the right predictions about our target sentences. That is, Kratzer’s (1981) truth conditions must make the right predictions about our target sentences from within a rigid designator framework. In this section it is argued that Kratzer’s (1981) truth conditions make the right predictions about counterfactuals like (58-59a) that have ‘physically impossible’ antecedents. However, a more robust exploration of this research question is needed before any conclusions can be confidently drawn.

In Section 5 we proposed that the antecedents of (53-54a), repeated here as (58-59a), are felicitous with respect to their local context of evaluation because the assignment function  $g_c$  from the actual world (in  $f(w)$ ) assigns John to  $j$  and Mary to  $m$ .

(58) Bill and Sarah are Mary's biological parents.

- a. If [JOHN]<sub>F</sub> had been Mary<sub>1</sub>'s biological father, she<sub>1</sub> would/might have had better genes.

(59) Mary was born in 1991.

- a. If Mary<sub>1</sub> had been born in [1993]<sub>F</sub>, she<sub>1</sub> would/might have had a better life.

However, we also observed that these assignments forced the biological/reproductive laws of the actual world out of every maximal set in  $A_w(q)$  because there are no possible worlds that share our natural laws in which John is Mary's biological father or Mary was born in 1993. Our assumption that proper names are rigid designators and adherence to Kripke's (1980) essentialist intuitions do not permit the existence of such worlds. We also observed that Kratzer's (1981) truth conditions require the maximal sets in  $A_w(q)$  to describe in which the antecedent is true, regardless of their implausibility. That is, so long as a maximal set in  $A_w(q)$  determines a counterfactual world that is *at least possible*, we can check to see whether a consequent  $r$  follows from it.

In section 1.4, we acknowledged that there are possible worlds that do not share our natural laws, although such worlds are often difficult to reason about. The antecedents in (58-59a) describe this sort of world where the biological/reproductive laws are forced out of every maximal set in  $A_w(q)$ . While such worlds may be difficult to reason about, it is plausible to assume imagining a world in which Mary could be born two years later is 'easier' than imagining a world where the laws of optics, or gravity, were different. Recall that in Section 1.4 we

speculated as to why the natural laws often persist into counterfactual situations. There we concluded that this phenomenon is likely due to our limited ability to conceive of worlds that are vastly different from our own. If we are on the right track, worlds with natural laws that are only slightly different from our own should be ‘easier’ to reason about counterfactually than worlds that are vastly different. This would account for the full acceptability of (58-59a) but the somewhat marginal status of (8a), repeated as (60) below.

(60) If I were looking into the mirror but did not see my face reflected, the laws of optics might be different.

According to Kratzer’s (1981) truth conditions, the strong (would) version of (58a) is true just in case every maximal set in  $A_w(q)$  entails that Mary has better genes in those worlds than she does in the actual world. The weak (might) version of (58a) is true just in case Mary has better genes in at least one maximal set in  $A_w(q)$ . It might appear *prima facie* that we are not in a position to evaluate the truth of claims about Mary’s genes in worlds with different biological laws. However, we can assume that the only changes in these worlds are those posited by the antecedent. That is, the only difference between our world and the worlds in which John is Mary’s biological father is that in the latter Mary is still Mary even though she has a different biological father. Such worlds are not difficult to imagine. In these worlds Mary might have different colored hair, be taller or shorter, or like painting pictures instead of playing basketball. If Mary is naturally gifted or less prone to genetic disease in these worlds, then we might be inclined to accept even the strong version of (58a).

Similarly, all of the worlds characterized by the maximal sets in  $A_w(q)$  for (59a) are worlds in which Mary is born in 1993. Although the antecedent  $q$ , forces the biological/reproductive laws of the actual world out of every maximal set in  $A_w(q)$ , it is not

difficult to imagine such a world. Perhaps Mary would have had a better life if she had been too young to process what was actually a traumatic childhood experience, or maybe she would have benefitted in no small way from having a mother that was two years the wiser.

In this section we have shown that Kratzer's (1981) truth conditions couched in a rigid designator framework that includes Kripke's (1980) essentialist intuitions, are able to provide adequate truth conditions for counterfactuals with 'physically impossible' antecedents. Our assumption that proper names are rigid designators requires us to remove the biological/reproductive laws of the actual world from every maximal set in  $A_w(q)$ . By removing this subset of the natural laws we are able to maintain the assignment function from the actual world context ( $f(w)$ ) and avoid incorrectly predicting that counterfactuals with 'physically impossible' antecedents are vacuously true because a proper name fails to rigidly designate its referent.

### **Conclusion**

This thesis provides felicity conditions for counterfactuals containing proper names in which essential changes to an individual are counterfactually posited using contrastive focus in either the antecedent or consequent clause. Starting with the observation that the antecedent clause of a counterfactual can felicitously host biologically 'impossible' propositions involving proper names, it is observed that these same 'impossible' propositions are infelicitous when located in the consequent clause. This contrast follows from a shift in the local context of evaluation from the antecedent to the consequent clause as proposed by Heim (1992, 2002). While the antecedent clause is evaluated with respect to the actual world, it also serves as the input context for the consequent clause. This provides the antecedent access to both the actual context and the set of all possible worlds, whereas the consequent only has access to the set of

worlds characterized by the antecedent. This asymmetry is the source of the contrast between the felicitous ‘impossible’ antecedents and the infelicitous ‘impossible’ consequents.

It is shown that if proper names rigidly designate the same individual in every world in which that individual exists, proper names in the consequent clause trigger infelicity when the worlds accessible from the antecedent clause do not contain a proper name’s referent. This, specifically, is shown to be the source of the infelicity of the ‘physically impossible’ consequent clauses in (2b) and (4b). By couching the proposed felicity conditions in a framework that treats names as rigid designators that are sensitive to the essential properties of their referents, it is shown that our felicity judgments about all eight sentences in (1)-(4) are correctly predicted.

As Section 6 suggests, the success of the felicity conditions proposed in the thesis crucially depend on the ability of Kratzer’s (1981) counterfactual truth conditions to make the right predictions from within a rigid designator/essentialist framework. While it is argued in Section 6 that this proposal is on the right track, further research regarding our ability to reason about and make reference to individuals in worlds that are radically different from our own will shed light on how fruitful this approach may ultimately be.

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