Against Counterexamples to Hypothetical Syllogism

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Abstract

A hypothetical syllogism with three conditional propositions (hereinafter HSc) is considered invalid according to the ordinary discourse counterexamples in the existing literature. In this paper, I argue that such counterexamples cannot verify the validity of HSc. The conditional propositions in these arguments are questionable, whether that is indicative or counterfactual HSc. The arguments are considered invalid not because HSc is invalid by itself, but because there is a mismatch between the antecedent of one premise and the consequent of another premise (i.e. a violation of the common part of both premises) in the syllogism, which seems to be a fallacy of equivocation. Such sentential structures of natural-language conditionals are problematic according to possible-world semantics. However, this study does not attempt to resolve the controversy of HSc by verifying whether it is logically valid in all circumstances, but rather to disqualify the counterexamples and illustrate their unclear syllogistic schemas.

Keywords: Hypothetical syllogism, Fallacy of equivocation, Counterexamples, Possible-world semantics.

1. Introduction

Hypothetical Syllogism (HS) is one of the two basic argument forms, while the other one is *Categorical Syllogism* (CS). A typical HS form has three propositions, where two are premises and one is the conclusion. Specifically, the two premises are used to discern that the conclusion is true. This paper discusses a controversial HS form, the alleged fallacy of the *transitivity* principle (Lowe 1990), which has the following schema:

If *P*, then *Q*.
If *Q*, then *R*.
Therefore, if *P*, then *R*.

This HS form has three propositions, which are all conditional (hereinafter HSc) with a typical first figure form and goes by different names, including *syllogisms by analogy*, *wholly HS*, and *wholly hypothetical arguments* (Bobzien 2000).

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According to Walters (2014a), its symbolic form is: $((P \Rightarrow Q) \wedge (Q \Rightarrow R)) \supset (P \Rightarrow R)$. In theory, HSc is valid when the conclusion strictly follows from the premises, such that "the premises, if true, necessitate the truth of the conclusion" (Mizrahi 2013: 40).

Despite support for its validity by advocates (e.g. Copi et al. 2007; Lowe 1990, 2010), it has been considered invalid by others (e.g. Mizrahi 2013; Morreau 2009; Walters 2014a, 2014b). Walters (2014a: 979) commented that "the debate is marked by one side providing a putative counterexample to HSc, and the other side invoking changes in context to explain it away". The reason philosophers return to it again and again with different ordinary discourse counterexamples is the lack of discussion of the real issue to end the debate.

Putative counterexamples are given to prove that HSc is invalid because both premises are true and the conclusion is false. For example, Mizrahi (2013) uses several counterexamples to contend that HSc is invalid for *indicative* conditionals, including the following one from Morreau (2009) (A1):

(1) If there was a thunderstorm, it rained.

(2) If it rained, there was an ordinary rain shower, not a thunderstorm.

Therefore,

(3) If there was a thunderstorm, there was an ordinary rain shower, not a thunderstorm.

Both Morreau and Mizrahi claim that (1) and (2) are true and yet (3) false; therefore, the result invalidates *indicative* HSc. Walters (2014b: 91) further mentions that there are similar counterexamples to reject *counterfactual* HSc. However, this study does not attempt to resolve the controversy of HSc by verifying whether it is logically valid in all circumstances, but rather to disqualify such counterexamples and illustrate their imprecise syllogistic schemas.

To disqualify the counterexamples, the material implication that fits conventional truth-table interpretations (i.e. the claim of truth preserving) is taken into account. Additionally, new semantics are explored to define counterfactuals, such as *possible-world semantics*.[1] This study incorporates these new thoughts to endorse an alternative analytical framework for natural-language conditionals. In the next section, I present valid HSc examples and point out issues with A1 in HSc invalidation. Then, I outline other counterexamples and describe their problems. Finally, I explain my modifications to the counterexamples and discuss why the material implication, despite possible failures in modeling natural-language conditionals where context-dependency is a known issue, works properly in this study.

2. Validity of HSc

I first cite two ordinary discourse examples from Morreau (2009), with slight modifications, to illustrate a valid HSc, where the counterfactual one (A2) is shown below:

(4) If there had been a rain shower, it would have rained.

(5) If it had rained, things would have gotten wet.

Therefore,

[1] One of the reviewers alerted me to the recent development of premise semantics.

(6) If there had been a rain shower, things would have gotten wet.

The indicative one (A3) is shown below:

(7) If there was a rain shower, it rained.

(8) If it rained, things got wet.

Therefore,

(9) If there was a rain shower, things got wet.

These two arguments are tautologically valid. It is also plausible to claim that counterfactual HSc is rendered equivalent to indicative HSc, consistent with Walters (2014b). However, the counterexamples given by Morreau, Mizrahi, and others, although being tautologically valid (e.g. according to the truth-table analysis), are considered invalid because the conclusion is false although both premises are true.

In this paper, I argue that their counterexamples cannot verify the validity of HSc. They overlook the problem of the conditional propositions in their counterexamples, whether that is an indicative or counterfactual HSc. The arguments are considered invalid not because HSc is invalid by itself, but because there is a mismatch between the antecedent of one premise and the consequent of the other premise (i.e. a violation of the common part of both premises). This seems to be a *fallacy of equivocation*, which refers to the misleading use of a term (a word or phrase) with more than one meaning or sense (Metzinger 2017: 101). Bobzien (2000) refers to the common part as the shared component in HSc. This is similar to the situation in CS where the middle term in the two premises must be consistent in meaning. As noted by Brand et al. (2022: 829) when they explained CS, "the goal of syllogistic reasoning is to interrelate the terms in the premises via the common middle term".

For A1, Morreau and Mizrahi (as well as Walters) fail to recognize that the common part "it rained" in the two premises is not consistent in meaning. Since thunderstorms and ordinary rain showers are two different contexts of the weather, relativists may then refer to (1)–(3) as a position of relativism where, according to Kölbel (2004: 299–300), "it is relative to P whether a thing has feature F" (Criterion 1), "there is at least one x and parameters p_i, p_j which belong to P, such that x has F in relation to p_i, but not in relation to p_j" (Criterion 2), and "there is no uniquely relevant choice of parameter" (Criterion 3); that is, "the possession of some feature is relative to some parameter" (298). In fact, the rain in a thunderstorm is thought to be heavier and last longer than the rain in an ordinary rain shower. In other words, whether the rain is heavy or not depends on whether there is a thunderstorm or an ordinary shower. Thus, the word 'rain' here is a relative term; that is, the rain relative to a thunderstorm is different from the rain relative to an ordinary shower. According to set theory, thunderstorms and ordinary rain showers are two separate features of weather that causes rain, either heavy or not-heavy rain, respectively (i.e. $p_i, p_j \subseteq P$ where $p_i \between p_j$). The sign $\between$ represents that p_i is contradictory to p_j; for example, heavy rain and not-heavy rain are contradictions in the set of rain P.

Moreover, the issue of the common part underscores that the sentential structure of the premises is problematic. This can be explained by *premise semantics* for accounts of conditionals. As noted by Egré and Rott (2021), the problem is about which consequent is appropriate to be conjoined to a given antecedent and which is not. They further refer to premise semantics as offering either ac-

ceptance or truth conditions for the consequent. In general, their discussion builds on *possible-world semantics*, which is raised by Angelika Kratzer and Frank Veltman whose semantics for conditionals is structurally equivalent to the standard variably-strict semantics for conditionals developed by David Lewis and Robert Stalnaker (Lewis 1981; Raidl 2021: 87; Rothschild 2015: 786). As a general rule, premise semantics mean that "a conditional is true at a world w if each set of basic beliefs or facts associated with this world that is maximally consistent with A (the antecedent), taken together with A, implies C (the consequent)" (Egré and Rott 2021).

Possible-world semantics come in assigning truth conditions to sentences where "in the set of all possible worlds W, a sentence ϕ can be true given a possible world w, but since w is genuinely possible, it cannot be the case that both ϕ and $\neg\phi$ are true at w" (Starr 2022). This is referred to as "an ordering on worlds" introduced by Stalnaker and Lewis; for example, the worlds w' and w" are compared with respect to their closeness to a benchmark world w, such that "$w' \preceq_w w$"" says that w' is closer to w than w" is (Santorio 2019: 3). As Santorio further cites from them, for "if ϕ, would ψ" to be true at w, it must be the case that "all ϕ-worlds that are closest according to $\preceq_w$ are ψ-worlds".

For A1, the consequent of (1) does not specify the condition of the rain relevant to a thunderstorm (since there is also an ordinary rain shower mentioned in the argument). For (1), the possible world that "it rained due to a thunderstorm" should be much closer to the actual world than the possible world that "it rained due to an ordinary rain shower" should be; for (2), the possible world that "it rained due to an ordinary rain shower" should be much closer to the actual world than the possible world that "it rained due to a thunderstorm" should be. Therefore, possible-world semantics indicate that natural-language examples may not conform to the requirement of HSc when the meaning of the common part in the argument is too wide and imprecise. For a 'real' HSc, it is necessary to state clearly which raining condition is mentioned in each of the premises. This problem can also be found in other counterexamples, which are discussed in the next section.

3. Disqualifying the Counterexamples to HSc

Besides A1 given by Morreau, another indicative counterexample, A4, is given by Mizrahi (2013) as follows:

(10) If I am in Boston at time t, then I am in a city whose name starts with the letter 'B' at time t.

(11) If I am in a city whose name starts with the letter 'B' at time t, then I might be in Baltimore at time t.

Therefore,

(12) If I am in Boston at time t, then I might be in Baltimore at time t.

Argument A4 has been disqualified by Walters (2014b: 90) who claims that Mizrahi "fail to take account the way in which conditionals and modals interact" and suggests that for a correct counterexample to indicative HSc, both Boston and Baltimore should be assigned a modal verb (i.e. the use of "might be"); therefore, (10) and (11) remain true, while (12) becomes false because it is *epistemically* impossible that one might be in Boston and, at the same time, might be in Baltimore.

While the effect of modality on the structure of an argument deserves attention, it seems that if I might be in Boston at time *t*, it is also possible that I might be in Baltimore at time *t*; conversely, if I am in Boston at time *t*, it is impossible that I am in Baltimore at time *t*. Therefore, the use of "might be" enables the truth of the two premises ("if I might be in Boston at time *t*, then I might be in a city whose name starts with the letter '*B*' at time *t*" and "if I might be in a city whose name starts with the letter '*B*' at time *t*, then I might be in Baltimore at time *t*") entailing the truth of the conclusion (if I might be in Boston at time *t*, then I might be in Baltimore at time *t*). On the other hand, since the consequent of (10) does not clearly mention which city (whose name starts with the letter '*B*') I am in, it does not strictly reflect the city Boston to which the antecedent refers. In fact, the consequent is too general to specify whether the city I am in is Boston (since there is another city, Baltimore, mentioned in this argument). Specifically, the possible world where the city (whose name starts with the letter '*B*') I am in is Boston should be much closer to the actual world than other possible worlds where the city (whose names start with the letter '*B*') I am in is Baltimore should be. Therefore, it is not clear which city the consequent mentions. Similar explanation applies to (11) as it is not clear which city the antecedent mentions.

Therefore, I disagree that the modal verb is the main reason to disqualify Mizrahi's counterexample, and reiterate that what invalidates the argument is the presence of lexical-semantic ambiguity. In fact, A4 has a similar problem as A1. The letter '*B*' in the first premise is different from the letter '*B*' in the second premise. The part "I am in a city whose name starts with the letter '*B*' at time t" is relative to the antecedent (i.e. Boston) in the first premise and to the consequent (i.e. Baltimore) in the second premise. Thus, despite the same wording, the word 'city' with the letter '*B*' in the common part of the two premises implicitly refers to two different cities. This relies on the sentential disorder to make a claim and is similar to what I have mentioned above the issue of context. Specifically, "a city whose name starts with the letter '*B*'" is a full set, while Boston and Baltimore belong to two independent subsets. In the next section, I will retain the conditionals with the original modal verb (i.e. might) to explain that modals are not effective in disqualifying this counterexample.

Mizrahi has also employed two counterexamples from Wright and Stalnaker for counterfactual HSc. The following argument (A5) originates from Wright (1983):

(13) If there had been snow in the valley yesterday, I would have gone skiing.

(14) If an avalanche had then been taking place, there would have been snow in the valley yesterday.

Therefore,

(15) If an avalanche had been taking place yesterday, I would have gone skiing.

Wright's example (A5) has encountered the same issue. The common part "there had been (or would have been) snow in the valley yesterday" does have different meanings in the two premises. The snow in the first premise refers to 'normal' snow that can be used for skiing, while the snow in the second premise refers to 'abnormal' snow (e.g. wet, powder, or slab snow) that is not conducive to skiing.

The following counterexample (A6) with counterfactual mood comes from Stalnaker (1968):

(16) If Hoover had been born in Russia, he would have been a communist.

(17) If Hoover had been a communist, he would have been a traitor.

Therefore,

(18) If Hoover had been born in Russia, he would have been a traitor.

The argument, A6, is somewhat different from other counterexamples mentioned above in that it can be either valid or invalid, while others are invalid. Mizrahi (2013) cites Lowe (1990) who states that Stalnaker's argument commits some sort of *fallacy of equivocation* (i.e. the *context-sensitivity* of counterfactuals), not invalidity. In fact, A6 is invalid (i.e. the conclusion, where Hoover who was born in Russia was a traitor, is false) if the common part of the two premises is inconsistent in meaning. For example, there may be two subsets of communists, one subset whose members are all traitors and the other subset whose members are not; therefore, the conclusion is false because Hoover might not have been a traitor even if he had been born in Russia. Conversely, if the common part of the two premises is consistent in meaning (i.e. all parameters in the set P are unanimous; thus, there are no subsets of the set of communists), this argument is valid due to a tautology.

4. The Correct Schema of the Counterexamples

I have contended that the common part in the two premises of the preceding counterexamples is not consistent in meaning. Therefore, the arguments in the counterexamples are invalid not because HSc itself is invalid, but because of the ambiguous common part used in the premises. I will further explain this by transforming these arguments to a modified schema where the two premises are true and the conclusion is false. As mentioned earlier, the common part is referred to as the shared component by Bobzien (2000), who further mentions that there is a bare component within the shared component, such that the shared component is the same as the bare component or transcends it by being assigned a different quality (either a negative or positive sign). For example, if C is the bare component, the shared component can be either C or $\sim C$. In other words, a bare component, which is identical in both premises, constitutes a necessary condition of an argument. Therefore, the validity of HSc can be checked by assessing whether the shared component (i.e. the common part), in the presence of a 'common' bare component, of the two premises is consistent. For A2 and A3, the meaning of rain is consistent in the two premises and both syllogisms are valid.

By assuming that rain can be heavy or not-heavy (where the bare component here is "it rained heavily"), A1 is modified as follows: P is "there was a thunderstorm"; Q is "it rained heavily" ($\sim Q$ is "it did not rain heavily"); R is "there was an ordinary rain shower, not a thunderstorm". A modified argument, A1', is formed with the following premises:

(19) If there was a thunderstorm, it rained heavily.

(20) If it did not rain heavily, there was an ordinary rain shower, not a thunderstorm.

For the modified argument, the two true premises (19) and (20) infer the false conclusion (9). Redefining the meaning of rain, as relative to thunderstorms and normal showers, has cleared the propositions in HSc, which is invalid according to truth-functioning that considers the two contradictory condi-

tions of the 'common' part (Q and $\sim Q$) in the two premises. The modified syllogism should be: $((P \Rightarrow Q) \wedge (\sim Q \Rightarrow R)) \supset (P \Rightarrow R)$. For it to be invalid, both premises must be true while the conclusion must be false. If $(P \Rightarrow R)$ is false, then P is true and R is false. Given that P is true and R is false, Q must be true in order for $(P \Rightarrow Q)$ and $(\sim Q \Rightarrow R)$ to be true. Thus, A1' is invalid if P and Q are true while R is false.

This can also be explained by possible-world semantics. For (19) of A1', the possible world of Q is now much closer to the actual world (P) than the possible world of $\sim Q$ is (i.e. all possible worlds of thunderstorms are all possible worlds of heavy rains rather than those of non-heavy rains). On the contrary, for (20), the possible world of $\sim Q$ is much closer to the actual world (R) than the possible world of Q is (i.e. all possible worlds of ordinary showers are all possible worlds of non-heavy rains rather than those of heavy rains). Since (19) and (20) are true and (3) is false, A1' is invalid. The modified argument indicates that the original A1 is not an authentic indicative HSc because the common part of the two premises is not consistent. Thus, Morreau's counterexample is disqualified.

Referring to (10) of A4, one possible solution to make people believe that it is Boston is to assign its respective state, Massachusetts, in the premise. By distinguishing the two geographical locations (Boston and Baltimore) with their respective states in the U.S., the argument can be modified as follows: P is "I am in Boston at time t"; Q is "I am in a city whose name starts with the letter 'B' in Massachusetts at time t" ($\sim Q$ is "I am not in a city whose name starts with the letter 'B' in Massachusetts at time t"); R is "I might be in Baltimore at time t". The modified premises are shown below:

(21) If I am in Boston at time t, then I am in a city whose name starts with the letter 'B' in Massachusetts at time t.

(22) If I am not in a city whose name starts with the letter 'B' in Massachusetts at time t, then I might be in Baltimore at time t.

In the modified argument, A4', the true premises (21) and (22) infer the false conclusion (12). Again, the possible world of Q is now much closer to the actual world (Boston) than the possible world of $\sim Q$ is, while the possible world of $\sim Q$ is much closer to the actual world (Baltimore) than the possible world of Q is.

In a similar vein, by assuming that snow is either normal or not normal (or abnormal), A5 can be modified as follows: P is "an avalanche had been taking place yesterday"; Q is "there would not have been normal snow in the valley yesterday" (and $\sim Q$ is "there had been normal snow in the valley yesterday"); R is "I would have gone skiing". A modified argument, A5', is formed with the following two premises:

(23) If an avalanche had been taking place yesterday, there would not have been normal snow in the valley yesterday.

(24) If there had been normal snow in the valley yesterday, I would have gone skiing.

Same as A4', A5' is invalid because the true premises (23) and (24) lead to the false conclusion (15).

As mentioned before, for A6 to be valid, there should be no subsets of the single set of communist and the consequent of (16) is equivalent to the antecedent of (17). Conversely, for A6 to be invalid, it is assumed that communists are

either a traitor or not a traitor (non-traitor), and the argument is modified as follows: *P* is "Hoover had been born in Russia"; *Q* is "he would have been a communist who was not a traitor" (and ~*Q* is "Hoover had been a communist who was a traitor"); *R* is "he would have been a traitor". The following two premises are formed for the modified argument A6':

(25) If Hoover had been born in Russia, he would have been a communist who was not a traitor.

(26) If Hoover had been a communist who was a traitor, he would have been a traitor.

In A6', the false conclusion (18) is deduced from the true premises (25) and (26).

Modified arguments (A4', A5', and A6') are all invalid, proving that their original counterparts are not a *bona fide* HSc, resulting in disqualifying the counterexamples of Mizrahi, Wright, and Stalnaker, respectively. In other words, their counterexamples that reject the conventional truth-functional analysis of HSc (e.g. they are considered valid by the truth table) are having flaws, while these modified arguments that support the conventional truth-functional analysis of HSc (e.g. they are considered invalid by the truth table) correct such flaws. The modified argument A4' has also confirmed that without the concern of modality raised by Walters (2014b), the counterexample can still be disqualified. In fact, such modified arguments emphasize the consistency in both lexical and sentential semantics, while the original arguments do not. As noted by von Fintel (2001: 141), "in classic logic, it is considered imperative that in the assessment of arguments the context remains stable". Although he points out the importance of committing to a stable context in logical argumentation, the real issue behind the terminology used in the premises has not been discussed. The counterexamples mentioned so far are dubious semantics that reject HSc by confusing the judgment process. However, such implicit semantics are ubiquitous throughout our human world, leading to the complex discourse environment. Moreover, the validity of the *transitivity* principle cannot be denied in the absence of effective counterexamples. In considering this, HSc is probably valid.

Finally, there may be concerns about the impact of *paradoxes* of the material implication on counterfactuals, which, according to Hermes (2014: 411), operate like material conditionals (e.g. truth-functional indicative conditionals, Hanson 1991) where their antecedents are false (subjunctive conditionals are a broader class of conditionals that their antecedents can be either true or false). This commonly known paradox is evident from a truth table that when the antecedent is false, the conditional is *vacuously* true. Lewis (1978) responds to this paradox, in terms of comparative similarity of possible worlds, by referring to counterfactuals as *variably-strict* conditionals. On his account, "*A* implies *C*" is (i) vacuously true if and only if *A* is true in no possible world (e.g. if *A* is logically or metaphysically impossible), (ii) non-vacuously true if and only if, for all possible worlds in which *A* is true, some worlds where *C* is true are closer to the actual world than any world where *C* is false, or (iii) false otherwise (e.g. Lewis 1978: 42). For (25) of A6', its *non-vacuous* truth consists in the fact that for all possible worlds where Hoover is born in Russia (*P*), there is at least one world where he is a communist who is not a traitor (*Q*) and which is closer to the actual world than any world where he is a communist who is a traitor (~*Q*) is. For (26) of A6', its *non-vacuous* truth consists in the fact that for all possible worlds where Hoover is a traitor (*R*), there is at least one world where he is a com-

munist who is a traitor (~*Q*) and which is closer to the actual world than any world where he is a communist who is not a traitor (*Q*) is. This also applies to A5'. Therefore, the issue of "vacuous truth" as a paradox of the material implication does not affect my modifications to counterexamples.

5. Conclusions

This paper aims to disqualify the existing counterexamples that attempted to refute the validity of HSc. Due to the use of inappropriate terms, such counterexamples have both lexical and semantic issues. By establishing the correct common part in both premises, the argument can be accurately interpreted. The paper demonstrates possible-world semantics to illustrate the importance of correct interpretations, which make the discussion clearer and easier to comprehend.[2]

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